An evaluation of equine headshaking syndrome and its management

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Abstract

Headshaking is a general term for a syndrome of behaviours that are exhibited by some horses when they are exercised. These include sudden, intermittent shaking of the head, excessive snorting and attempts to rub the nose. Examination by the veterinary surgeon is often inconclusive (Lane and Mair 1987) although such horses may become unrideable and, if severely affected, destroyed. Advances in our understanding of the causes of the syndrome have been hampered by the absence of effective treatments and a preponderance of case reports over controlled, epidemiological studies.

In this thesis, a range of epidemiological techniques were employed to answer questions relating to the presentation, aetiology and treatment of the syndrome. A case-control survey of 83 headshakers found no evidence to suggest that aspects of the management of the horse were significant, general risk factors. Inferences from the reports of 200 horse owners regarding the presentation of the syndrome, the intermittency of its appearance and association with trigger factors supported a proximate aetiology of nasal irritation. A field trial of a bitless bridle and a light-limiting facemask suggested that the presence of the bit or light alone are not significant triggers for British headshakers. This is in contrast to reports from the USA, which, in the absence of evidence of any difference in presentation of the syndrome, suggests that headshaking syndrome is the final common pathway for irritation caused by a number of different factors.

An appropriate methodology for the assessment of the efficacy of alternative and complementary therapies for headshaking was described using the principles of clinical trials. The use of the horse-owner as the assessor of change in the headshaking signs was supported by a demonstration of the consistency of their reports. Two double-blinded, placebo-controlled cross-over trials, conducted according to the methodology, reported no evidence of any specific effect of an herbal supplement or a magnatherapy headcollar. However, significant improvement was reported in the horses under both placebo and verum conditions. This supports the assertion that control for the non-specific effects of treatment by placebo is essential if progress is to be made in understanding the aetiology and treatment of headshaking.

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Preface

Presentation of the thesis

The thesis is presented in four parts:

Part 1 describes the results from a case-control survey to investigate the significance of various health, management and behavioural factors in horses described as headshakers.

Part II describes the results from a large, observational study (a postal survey) of 200 headshakers from the UK. The results regarding the reported onset and progression of the condition, association with environmental circumstances and success of conventional and non-conventional interventions are presented. Comparisons between this and other surveys in the literature are made. And, various attempts to classify the headshakers using multivariate analysis of their presenting signs are reported.

Since owners are commonly used as assessors of their horse's problem, **Part III** describes a series of experiments to assess the consistency of their reports: in a video observation exercise, between surveys competed at different times and between a single observation and a general report.

Given the apparent use and success of non-conventional interventions for the prevention of headshaking attacks but the lack of any scientific evaluation of these, **Part IV** describes a methodology for how this might be attempted based on the principles of clinical trial design. The results from two simple field trials and two double-blind, placebo-controlled, cross-over trials carried out using this methodology are presented.

General use of terms

'Headshaking' is used loosely to describe the 'idiopathic headshaking syndrome' or 'headshaking condition' in addition to the behavioural act of shaking the head.

'Horses' include horses and ponies.

'Behavioural sign' is used to describe the behaviours of the headshaking syndrome. Each specified behavioural sign listed in the survey first described in Chapter 3 is expressed in italics throughout, for example, *vertical headshaking*

'Situation' is the term given to environmental and physiological circumstances under which headshaking might be reported to be more or less likely to occur. Each specified situation listed in the survey first described in Chapter 3 is expressed in italics throughout, for example, when *excited.*

'Management aids or devices' are fashioned materials applied to external part of the horse's body in order to prevent or reducing headshaking, for example, nose nets, facemasks, and variants of normal 'tack' e.g. bridles and draw reins.

'Alternative and complementary therapies' are any interventions not based on traditional, Western, veterinary, medical practice that are used in the absence of or alongside traditional veterinary interventions, for example, traditional Chinese medicine or homeopathy. The term 'non-conventional' is also used to describe these types of therapies.

Breed classifications

Horses were classified as in Mellor *et al.* (1999) into the following groups: thoroughbred (TB), cob, pony, warmblood and other. If their predominant breed was thoroughbred, cob, pony or warmblood, crosses were included under this category. All other crosses were included as other.

Pers obs. Personal observations of the author, from direct observations of headshakers in the field or from discussion with owners

Pers. comm. Personal communication with the author, including telephone and email discussions

Statistical conventions

Summary statistics are presented in the form: Mean, SD (standard deviation), (Median), Range and *N* (number of values).

Unless indicated otherwise all statistics were computed using S-Plus 2000 (Mathsoft Inc, USA).

Test results are given in the form: test statistic (to 2 decimal places), DF (degrees of freedom), p (probability value, to 3 decimal places). A $p<0.05$ was considered significant evidence of a difference, $0.05<p<0.1$ was considered a noteworthy trend. Exact p-values (Fisher's exact test, SAS v 8.0, SAS Institute, Inc) are shown in parentheses where applicable (where more than 25% of the expected counts in a cross tabulation are of the value of 5 or less).

For Wilcoxon signed-rank tests (for paired data) *N* for test indicates the number of horses for which there is a non-zero difference in observations. For Wilcoxon rank sum tests (for unpaired data, equivalent to a Mann-Whitney) *N* for test indicates the number of horses with a non-zero value, two values given. P-values are always given adjusted for ties, where applicable.

Chapter 1

Introduction

1.1 Headshaking in horses

Shaking the head is a natural behaviour for equids, which probably evolved as a reaction to biting insects (Cook 1979a). It is also thought to reflect short-term frustration (Cook 1979a). For example, short bouts of vertical or rotary headshaking have been observed in horses being held back at a race (Cook 1979a), when separated from conspecifics (Cook 1992) or when restricted from moving (Kiley-Worthington 1987). Repetitive head movements are also observed, often when the horse is stabled (Cook 1979a). 'Head nodding', 'head bobbing' and 'weaving' are repetitive locomotory behaviours that have variously been labelled as vices, stereotypies or obsessive compulsive disorders (Luescher *et al.* 1991). Regardless of the term, however, these movements are thought to be indicative of more chronic frustration to perform behaviours that are limited by the restricted environment of the stable (Cooper *et al.* 2000). Another cause of head 'nodding' relates to lameness. A horse will raise or drop the head depending on whether an affected fore- or hind-limb, respectively, has just touched the ground, in order to shift its mass away from the load-bearing limb (Adams 1974).

'Headshaker', however, is a term given to a horse which, during exercise, exhibits 'intermittent, sudden and apparently involuntary head tossing of an extravagant kind' (Cook 1979a). The headshaking usually occurs when the horse is ridden and may either persist or deteriorate until the horse becomes uncomfortable to sit on or dangerous to ride. For this reason headshakers may be difficult to train or hack out[1] safely. The

[1] Riding on roads or country lanes

problem therefore has the potential to profoundly affect the relationship between horse and owner/rider. A horse is estimated to cost £2,000 a year on average to house, feed and care for (Produce Studies Group 1999). Many owners cannot therefore justify keeping an animal that they are not able to use for business (i.e. riding school or competition) or pleasure. As a result, headshakers are often sold on, sometimes to new owners who are not fully aware of the horse's problem (Lane and Mair 1987, Newton *et al.* 2000). In more severe cases euthanasia may be a rational option since it is felt that these horses are in considerable pain (Newton *et al.* 2000). Headshaking is therefore not only a problem of clinical interest but an important welfare concern.

1.2 Headshaking as a presenting sign of disease

Although first described in the veterinary literature in the early nineteenth century (Lawrence 1809), headshaking received little scientific attention until the latter part of the twentieth century. This resurgence of interest was led by a series of papers by Cook, which attempted to describe the condition (Cook 1979a, b, 1980a, b). Cook listed nearly 60 diseases that might be considered as possible causes of headshaking. These included respiratory infections, allergies, facial, ocular, aural or dental pain and ocular or aural infections, amongst others (Cook 1980b). However, he reported that, "at the present state of our knowledge it is seldom possible to offer an exact diagnosis of the cause" (Cook 1979a).

Since the contributions of Cook, there have been several reports in the veterinary literature of diseases for which headshaking was a presenting sign, but most have been isolated case reports involving a handful of horses. Referral for headshaking and cessation following treatment has been reported for sinusitis (a ball of pus in the sinus) (one horse–Barrett 1946), *Psoroptes* mites in the ear canal (one horse–Gerring and Thomsett 1980), maxillary osteoma (one horse–Kold and Ostblom 1982), vasomotor rhinitis (one horse–McGorum and Dixon 1990), *Trombicula autumnalis* infestation of the nares (two horses–Mair 1994), parotid gland melanomas (one horse–Tietje *et al.* 1996) and equine protozoal myeloencephalitis (EPM) (three horses–Moore *et al.* 1997).

Cessation of the headshaking following treatment for the disease in question however does not necessarily imply that the disease was the cause of the headshaking. Headshaking has also been observed in horses found to have nasal sinus tumours (3 out of 28 tumour cases–Dixon and Head 1999), otitis media/interna (one out of four cases–Hassel *et al.* 1995, 17 out of 26 cases–Blythe *et al.* 1990) and temporohyoid osteoarthropathy (1 out of 3 cases–Blythe *et al.* 1984, four out of 33 cases–Walker *et al.* 2002).

Headshaking may therefore be indicative of a number of pathologies that cause pain or irritation in the head. However, in the majority of cases these are not identified through the usual investigations by a veterinary surgeon (Mayhew 1992). The authors of a survey of 100 horses referred to their surgery for headshaking over 10 years could find potential causes in only 11 of the horses (Lane and Mair 1987). These were ear mites (three horses), cervical spinal injury (two horses), guttural pouch mycosis, melanotic iris cysts, otitis interna, cranial neuropathy, dental periapical abscess and vasomotor rhinitis (one horse each). However, following treatment of four of these cases, only two horses improved (guttural pouch mycosis and melanotic iris cysts). Those diagnosed with ear mites and a dental abscess continued to headshake following treatment. These, and the remaining horses, were diagnosed as 'idiopathic headshakers' (headshaking of unknown aetiology) and it is about these horses that speculation and interest has developed.

1.3 The idiopathic syndrome

1.3.1 Presentation of signs

Although headshaking is a presenting sign of disease, what remains in many horses is a syndrome of behaviours that is treated much like a disease entity although no specific explanation for its occurrence has been confirmed. The behaviours seen in horses described as idiopathic headshakers tend to be similar and have been described by several authors (Williams 1897; Lane and Mair 1987; Madigan and Bell 2001; Mills *et al.* 2002a). Not surprisingly, the headshaking 'attack' that occurs is a key component to the behaviour. It has been variously described as "a series of vertical flicks or jerks that may become more exaggerated" (Pinsent 1990), "a sudden reflex spasm...some (horses) toss their heads in a dorsal arc of movement...others duck their heads ventrally" (Cook 1979a) or a "sudden jerk or shake, as though tormented by insects" (Williams 1897). Headshakers have also been observed to shake their heads from side to side or in a circular or rotary manner (Cook 1979a; Lane and Mair 1987). Most agree that the movement is an involuntary reflex and is not to be confused with an exaggeration of the normal nodding that occurs at the walk or when the horse is lame (Cook 1979a).

However, the syndrome usually also involves other behaviours that are thought to be largely indicative of naso-facial irritation (Mills *et al.* 2002a). For example, the horse may also snort or sneeze with the headshaking, drag its nose along the ground, rub its nose on its foreleg, the rider's leg or on nearby objects such as fence posts (Mills *et al.* 2002a). Striking out with the foreleg whilst headshaking (Cook 1979a) and hitting the face with the foreleg has been reported (Mair and Lane 1990, Madigan *et al.* 1995). Horses have also been reported to clamp the nostrils as if to protect the nasal passages from irritants (Knottenbelt 1998) or attempt to hide or protect the head (Madigan *et al.* 1995). Owners often report nasal rubbing and a nasal or ocular discharge following exercise (Mair and Lane 1990, Cook 1980b). In summary, the horse can often be described as "acting as if an insect was flying up the nostril" (Madigan and Bell 2001), although the reaction may be more to one of acute pain (Newton *et al.* 2000). Table 1.1 lists the signs described by five authors who have surveyed the condition in a number of horses. Mills *et al.* (2000a) listed other signs reported in a few headshakers which may or may not be part of the syndrome. However, no-one to date has presented a comprehensive summary of the prevalence of all these listed signs in a large sample of horses considered to be suffering from the headshaking problem.

Table 1.1 The clinical signs and their noted prevalence reported in horses described as headshakers in five surveys; Lane and Mair (1987)–100 horses, Madigan *et al.* (1995)–7 horses, Newton *et al.* (2000)–20 horses, Madigan and Bell (2001)–109 horses and Mills *et al.* (2002a)–254 horses.

Clinical sign	Authors reporting it and prevalence, if presented
Headshaking	Lane and Mair (1987)–100%, Madigan *et al.* (1995)–100%, Newton *et al.* (2000)–100%, Mills *et al.* (2002a)–100% *Vertical:* Lane & Mair (1987)–87%, Madigan *et al.* (1995), Madigan and Bell (2001)–89%, Mills *et al.* (2002a)–92% *Horizontal:* Lane & Mair (1987)–15%, Madigan *et al.* (1995), Mills *et al.* (2002a)–25% *Rotary:* Lane & Mair (1987)–7%
Rubbing the nose	Lane and Mair (1987)–60%, Madigan *et al.* (1995)–71%, Newton *et al.* (2000)–80% *On objects:* Madigan and Bell (2001)–75%, Mills *et al.* (2002a)–79% *On foreleg:* Lane & Mair (1987), Madigan *et al.* (1995) *On rider's leg:* Lane and Mair (1987) Madigan *et al.* (1995)
Snorting/sneezing	Lane & Mair (1987)–51%, Madigan *et al.* (1995)–57%, Newton *et al.* (2000)–15%, Madigan and Bell (2001)–64%, Mills *et al.* (2002a)–73%
Rubbing nose along the ground	Lane & Mair (1987), Madigan *et al.* (1995), Newton *et al.* (2000)–10%, Mills *et al.* (2002a)–44%
Striking of foreleg onto nose	Lane & Mair (1987), Madigan *et al.* (1995)–14% Newton *et al.* (2000)–25%, Mills *et al.* (2002a)–63%
Nasal discharge	Lane & Mair (1987)–47%, Madigan *et al.* (1995)–14%, Newton *et al.* (2000)–40%, Mills *et al.* (2002a)
Flipping of nose	Madigan *et al.* (1995)–29%, Mills *et al.* (2002a)–72%
Odd head carriage	Newton *et al.* (2000)–15% ('low'), Mills *et al.* (2002a)
Clamping the nostrils	Newton *et al.* (2000)–10%, Mills *et al.* (2002a)
Excessive lacrimation	Lane & Mair (1987)–13%, Newton *et al.* (2000)–35% (ocular discharge), Mills *et al.* (2002a)
Twitching	Newton *et al.* (2000)–15% (facial muscles), Mills *et al.* (2002a)
Acting like a bee flew up nose	Madigan *et al.* (1995), Madigan and Bell (2001)–88%, Mills *et al.* (2002a)–72%
Coughing	Lane & Mair (1987)–27%, Newton *et al.* (2000)–20% Mills *et al.* (2002a)
Attempts to hide the head	Madigan *et al.* (1995)–71% *In corner of stable:* Lane & Mair (1987), Madigan *et al.* (1995) *In a bush:* Madigan *et al.* (1995), Mills *et al.* (2002a) *In a water barrel:* Madigan *et al.* (1995), Mills *et al.* (2002a) *In another horse's tail:* Madigan *et al.* (1995) *Shade seeking:* Madigan and Bell (2001)–30%, Mills *et al.* (2002a)
Head pressing	Newton *et al.* (2000)–20%, Mills *et al.* (2002a) ('banging')
Anxious expression	Madigan and Bell (2001)–61%, Mills *et al.* (2002a)
Nasolabialis muscle hypertrophy	Newton *et al.* (2000)–10%
Eye rubbing	Newton *et al.* (2000)–5%

1.3.2 Prevalence of the problem

Horses with this problem have been reported in North America, Australasia and Europe (Madigan and Bell 2001), although the majority of published studies have been from the UK and USA. The reported prevalence of the problem has yet to be established in either location, but, in the UK at least, the problem is widely recognised (Mair and Lane 1990). In the early 1960s, the British Equine Veterinary Association Survey of Equine Disease reported 11 cases of headshaking among 17,268 surveyed horses (BEVA 1965). Whilst there is a feeling that the problem has been on the increase over the last 20 years (Mair and Lane 1990), it is not yet known whether this is indeed the case or that our greater awareness over this time has meant that more cases are being identified by the veterinary surgeon and the owner.

Headshaking has been reported in horses of various breeds (Lane and Mair 1987, Madigan *et al.* 1995, Newton *et al.* 2000, Mills *et al.* 2002a), including warmbloods, ponies and crossbreeds. However, it has been suggested that thoroughbreds might be overrepresented in the headshaking population (Cook 1979a, Madigan and Bell 2001). Cook (1992) postulated that this might be a consequence of their genetic similarity and high-strung temperament, which makes them more likely to respond excessively to irritating stimuli. The problem has also been reported in horses of various disciplines and levels of sporting achievement (Lane and Mair 1987, Newton *et al.* 2000). However, it has been suggested that the discipline of dressage is overrepresented (Cook 1979a) and the racing community underrepresented (Mills pers. comm.). Finally, a pattern of a higher proportion of castrated males (geldings) than females (mares) being affected has been consistently reported, and appears to be in the region of approximately two geldings to every mare (Lane and Mair 1987, Newton *et al.* 2000, Madigan and Bell 2001, Mills *et al.* 2002a). However, as with the other associations, there has been little direct comparison with the general population to see if these are in fact overrepresentations or just reflections of the norm.

1.3.3 Seasonality pattern of the syndrome

A common feature of the syndrome is the reported seasonal pattern of the occurrence and severity of the headshaking attacks. A pattern of appearance of signs in the spring that increase in intensity throughout the summer, apparently subsiding towards the winter-time only to appear again in the following spring has been frequently reported (Cook 1979b, Madigan *et al.* 1995). Lane and Mair (1987) found that 66% of the idiopathic headshakers (out of 29 that had been headshaking for more than 18 months) followed such a pattern. Madigan and Bell (2001) reported it in 53% of their sample of horses and Mills *et al* (2002a) in 63%, calling such affected horses 'sunny-seasonal headshakers'. Almost all remaining horses from these two surveys shook to some extent all year round. A few cases had a very short seasonal pattern, i.e. headshaking in the autumn or spring only (six horses–Madigan and Bell 2001, one horse–Mills *et al.* 2002a) or an inverted seasonal pattern, i.e. shaking over the winter-spring period only (three horses–Madigan and Bell 2001, two horses–Mills *et al.* 2002a). By contrast, Williams (1897) reported the reverse of this pattern, i.e. that the problem was mostly evident over the winter. One suggestion for this might be the increase in smog at this time of year, which was common at the turn of the century (Mills, pers. comm.).

This seasonal pattern reported by the owners is frequently used to explain possible aetiologies, see below, but there are still misgivings as to its direct relationship to the severity and occurrence of the headshaking. Cook (1992) has suggested that it may be more a reflection of the horse being trained or ridden more in the summer. In this way, the condition may only appear to be more apparent to the owner and/or the increase in work affects the headshaking rather than the time of year. It is important to establish if this is likely to be the case. This could be done by obtaining a more detailed report of the horse's seasonal headshaking pattern and relating it to the horse's usual work rate over the year.

1.3.4 Progression of the syndrome

Mills *et al.* (2002a) found that the reports of changes in intensity of the headshaking and length of season from one year to the next tended to be correlated, and that the majority of horses were not reported to change in either measure year on year. This is in contrast to previous reports that the headshaking usually deteriorates over time (Williams 1899, Newton *et al.* 2000, Vogel 1996). Deterioration can occur by the severity of the signs increasing (Newton *et al.* 2000), the signs becoming apparent at other paces, even at rest (Lane and Mair 1987) or by horses that were affected only seasonally beginning to show signs all year round (Lane and Mair 1987, Newton *et al.* 2000, Mills *et al.* 2002a). However, there are also reports of headshakers spontaneously improving (or worsening) when the horse is moved to different areas of the country, e.g. when sold or taken to a show (Lane and Mair 1987, Knottenbelt 1998, Pinsent 1990). Clearly, the reported change in severity and occurrence of the headshaking over time and location needs to be more thoroughly evaluated, so that explanations for these changes can be related to aetiology.

1.3.5 Other effects on the occurrence and severity of signs

Another feature of headshaking is its apparent relationship with 'triggers' or factors that may exacerbate a headshaking attack. The most common trigger and exacerbator reported for most horses is exercise itself. Frequently, headshaking signs do not appear until the horse is 'warm', i.e. 5–10 minutes following the onset of exercise (Cook 1979a, Mair and Lane 1990). The severity of signs also tend to progress as the horse is exercised (Mair and Lane 1990). Why exercise might precipitate the headshaking is still unknown but this is a source of speculation (Madigan and Bell 2001). Headshaking is usually most apparent when the horse is trotting (Cook 1979a, Mair and Lane 1990), but why this should be has also not been determined. Headshaking is rarely reported at the canter or gallop, perhaps because it is not possible to perform both feats simultaneously. But, it has been noted at the walk or at total rest, perhaps in more severely affected cases (Madigan *et al.* 1995).

Environmental conditions, such as the weather and the location in which the horse is worked, have also been reported by the horse's owner to affect the occurrence and severity of the headshaking. Horses are frequently reported to be worse on bright, sunny days (Lane and Mair 1987, Madigan *et al.* 1995, Mills *et al.* 2002a). 64% of the horses in the study by Mills *et al.* (2002a) were reported by their owners to be worse on bright, sunny days. Conversely, owners reported an improvement if the horse was ridden on rainy days, indoors or at night (Mills *et al.* 2002a). Lane and Mair (1987) reported only three horses to be worse on windy or rainy days and none on cold days. By contrast, 35 were reported to be worse on warm, sunny days. The location in which the horse is exercised has also been associated with an increase or reduction in the occurrence or severity of the headshaking. Lane and Mair (1987) mentioned that some horses were reported to be particularly affected when ridden past trees or down narrow lanes. This association was reiterated by owners in an open-ended section of the survey by Mills *et al.* (2002a).

Only some of these potential triggers, such as the effect of exercise, have been verified by veterinary surgeons in controlled settings. They may therefore be a consequence of the owner's interpretation of events and an imagined association with the occurrence of the headshaking that does not reflect reality. Reporting of the effect of various locations and weather conditions has largely been dependent on the owner's volunteered recollection in questionnaires (Mills *et al.* 2002a) or reports to veterinary surgeons (Lane and Mair 1987, Madigan and Bell 2001). Before it is possible to tease out what it might be about these situations that affects the headshaking, a more complete record of these instances needs to be produced in a large sample of horses from which their relative and likely effect can be evaluated. Veterinary surgeons may only see the horse on one or two relatively brief occasions and as such only get a 'snapshot' of what is clearly an intermittent condition in most cases. Owners may be in a better position to assess the occurrence of their horse's signs over time and location. However, it remains to be established how reliable, and hence useful, their reports are likely to be.

1.4 Principle theories regarding the aetiology of the idiopathic syndrome

Several theories regarding the possible aetiology (cause) of the idiopathic condition have been put forward in recent years. These have been based not only on the horses' symptomatology but the apparent relationship between the appearance of signs and a range of trigger factors. Four of the principle theories: stereotypy, exercise intolerance, allergic rhinitis and neurological causes, are discussed below.

1.4.1 Stereotypy

Stereotypies are defined as "repetitive, invariant behaviour patterns with no obvious goal or function" (Mason 1991). Examples include stall-walking and weaving in stabled horses. Headshaking behaviour has been discussed in the same context as stereotypies elsewhere in the literature (Fraser 1992, Houpt and McDonnell 1993, Kiley-Worthington 1983, 1987). This is perhaps not surprising given some similarities between headshaking and other stereotypic behaviours. For example, there is also no obvious reason for the headshaking behaviour and it does not tend to respond well to treatment. Components of the behaviour may be similar to other stereotypical behaviours such as star-gazing/staring, lip-flapping, head twisting/flicking, foreleg lifting and head bobbing or nodding (Luescher *et al.* 1998). The close association between headshaking and ridden work may also suggest to the observer that the behaviour is psychological. For example, the horse might be reacting to boredom or frustration, which is a common explanation for stereotypies. However, it is unlikely that idiopathic headshaking *per se* fits into the definition of stereotypy provided by Mason (1991). This is because;

1. The occurrence of the headshaking is usually unpredictable; owners make associations between the headshaking attacks and the prevailing environmental or seasonal conditions in an attempt to explain the occurrence of the behaviour (Lane and Mair 1987, Mills *et al.* 2002a)
2. The headshaking condition is reported to change over time, deterioration and, sometimes spontaneous, improvements are both reported (Lane and Mair 1987, Mills *et al.* 2002a).

3. The presentation of the condition usually involves other signs that more resemble a response to genuine naso-facial irritation (Lane and Mair 1987, Mills *et al.* 2002a).

Nonetheless, it has been suggested that headshaking might become a 'habit' in that, even though the initial stimulus has long since gone, the headshaking remains (Mills and Nankervis 1999, Mayhew 1992). Learned components might also reinforce the behaviour (Scott 2001). Other researchers argue that once the source of pain or irritation has been removed the headshaking usually stops (Cook pers. comm., Knottenbelt pers. comm.). It is possible, however, that some horses with stereotypic problems that occur usually at rest, such as 'head-bobbers' or 'nodders' (see Cooper *et al.* 2000), are mistakenly classified as 'headshakers' by those not familiar with the condition. It is therefore important to define the headshaking condition and clarify the behavioural differences between it and stereotypies in order to resolve this confusion.

1.4.2 Exercise intolerance

It has been suggested that, "most headshakers are partly asphyxiated horses expressing a temperamental unwillingness to comply with rider's requests for head flexion and precise leg movements" (Cook 1992). In Cook's experience at this time the majority of headshakers he had observed were, "mature thoroughbreds, trained for dressage and owned by women" (Cook 1979a). This presumably led him to suggest that the form of exercise the horses were engaged in caused or contributed to the headshaking problem. Cook suggested that the action of poll flexion (pulling in the head so that it is nearly vertical–a requirement of dressage work), whilst the horse extends its forelimbs in trot puts considerable strain on the horse's airways and spine. More temperamental horses (such as thoroughbreds) may therefore throw their heads in response to this discomfort and/or in order to open their airway. Cook suggested that the seasonal nature of the condition might be explained by increased exercise over the summer months, heat and humidity "...exacerbating hypoxia in an already partially asphyxiated horse" (Cook 1980a).

Cook's theory has not been supported by other authors, perhaps because hypoxia and/or frustration would not explain the other signs of nasal irritation that frequently accompany the headshaking. It is also well established that many cases will also headshake at total rest (42%–Lane and Mair 1987, Newton *et al.* 2000, 55%–Madigan and Bell 2001, 41%–Mills *et al.* 2002a) which excludes the possibility that it is just a temporary reaction to extreme poll flexion, at least in these cases. Nonetheless owners are encouraged to try lunging their horse without tack and rider to discover if the form of the exercise, the presence of the rider or the tack (bridle and saddle) could be the cause of the irritation (Cook 1979b, Knottenbelt 1998, Mair and Lane 1990). To date, results from such checks have not been reported, although Madigan and Bell (2001) did report that only 10% of the horses in their survey shook only when ridden.

1.4.3 Allergic rhinitis

Rhinitis is an "inflammation of the mucous membranes of the nose" (Pearsall 2002). It was suggested by Cook (1980a) as a possible cause of headshaking, either as a consequence of an immune-mediated hypersensitivity response to allergens (allergic rhinitis) or as a hyper-responsiveness to non-specific stimuli (vasomotor rhinitis). Lane and Mair (1987) suggested that the clinical signs of nasal irritation, a marked seasonal onset and exacerbation with exercise or change of environment in the majority of their sample of idiopathic headshakers closely resembled that of allergic rhinitis in man. They further suggested that the headshaking seasonality patterns might follow flowering seasons of specific crops such as oilseed rape or the appearance of leaf moulds (Mair and Lane 1990). Since signs of other hypersensitivity conditions, such as chronic obstructive pulmonary disease (COPD), have been reported in headshakers it has been suggested that these conditions might be related (Lane and Mair 1987).

There has been, however, a lack of supporting evidence from reports of treatment for allergic rhinitis. Mair *et al.* (1992) reported partial improvement in 3 out of 9 horses with corticosteroid beclomethasone nasal spray, but none with other anti-inflammatory or antihistamine drugs. Madigan *et al.* (1995) also reported a lack of success with antihistamines and steroids in their small study. The personal experience of many veterinary surgeons is that antihistamines are unsuccessful in treating headshakers (e.g. Wilkins 1997). Headshaking has also been reported to be less responsive to neutralisation techniques[2] than other conditions, such as COPD or urticaria, which are considered to be allergic (Burrell and Mansfield 1997, Tallarico and Tallarico 1998). To date, only one confirmation of allergic rhinitis via biopsy in a headshaker has been reported (Newton *et al.* 2000). This team also reported that post mortem analysis of headshakers failed to find evidence of allergy, or any other pathology (Kelly, pers. comm., cited in Newton *et al.* 2000). As a result, allergic rhinitis is not considered to be a major cause of headshaking by some veterinary surgeons (e.g. Newton *et al.* 2000), although it appears to be a popular explanation amongst owners (pers. obs.).

1.4.4 Neurological causes

The lack of evidence of any obvious pathology in the majority of reported headshakers and the poor effect of antihistamines or anti-inflammatory treatment has led many authors to suggest that the cause of the problem might lie directly in the nerves of the head. It was first suggested by Williams (1897) that headshakers might be suffering from trigeminal neuralgia (peripheral neural pain of the fifth cranial nerve. This theory was later reiterated by Huttyra and Marek (1926), Neal and Ramsey (1972), Cook (1980b) and Madigan *et al.* (1995). Branches of the trigeminal nerve provide sensation to the muzzle and parts of the face (see Fig. 1.1). Neuralgia or hypersensitivity in these nerves may result in pain and irritation to which the horse reacts by snorting, rubbing the nose and flipping the head (Madigan *et al.* 1995).

[2] injecting the subject with minute quantities of an allergen in order to provoke long lasting immunity

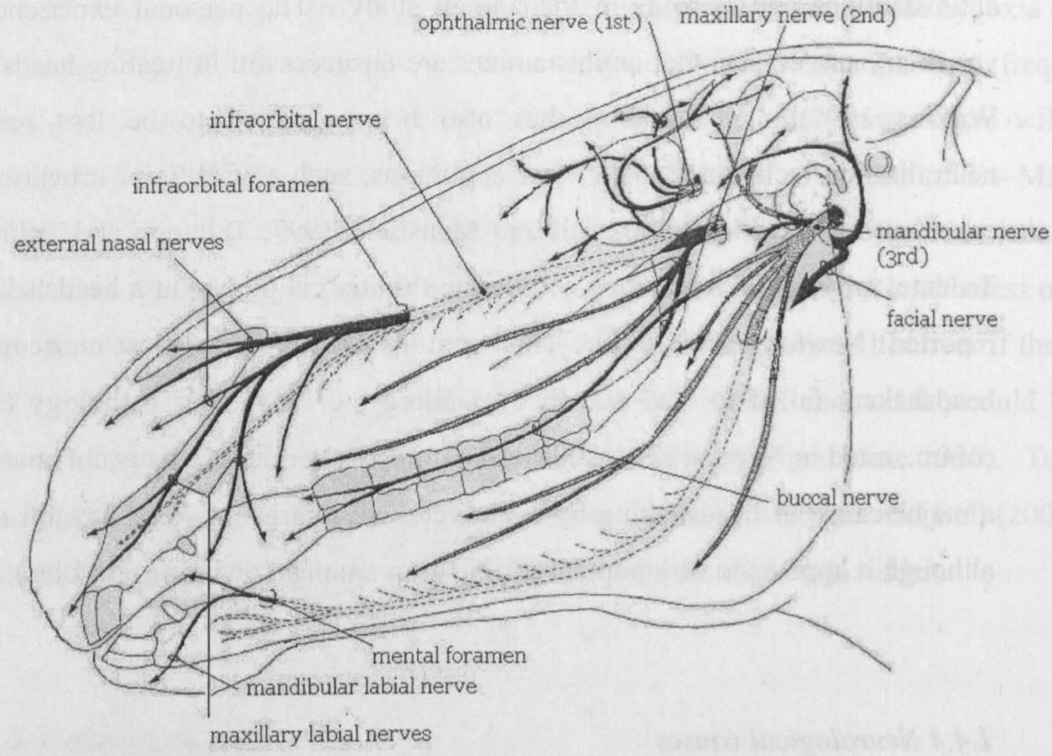

Fig. 1.1 The trigeminal nerve distribution in the horse's head. The three branches of the trigeminal are shown (ophthalmic (1st), maxillary (2nd) and mandibular (3rd)). Adapted from Goody (2000).

Madigan *et al.* (1995) suggested that the cause of irritation in the horse's nose could be as a result of optic-trigeminal summation, a process known to cause the 'photic sneeze' in humans (Everett 1964). Stimulation of the optic nerve by light may lead to activation of other nerves lying close by. If the maxillary branch of the trigeminal is activated (see Fig.1.1) a 'tickling' sensation may result in the nasal mucosa, which causes a sneeze (Madigan and Bell 2001). Madigan *et al.* (1995) postulated that such a tickling sensation could cause the headshaking and nasal rubbing observed in these horses. In support of this they reported success with blindfolding in five horses and at least partial success with the drug cyproheptadine in five out of seven horses (Madigan *et al.* 1995). Cyproheptadine is a histamine and serotonin blocking agent with anticholinergic effects and is used for various allergies in humans (Madigan *et al.* 1995). Rather than preventing the signs of allergic rhinitis, Madigan *et al.* (1995) suggested that cyproheptadine might act on trigeminal nerve-mediated facial sensation via its anticholinergic properties or effect on central production of melatonin or serotonin. They later presented results from owners who had reported moderate to great improvement with cyproheptadine in 70% of cases (43/61 horses–Madigan and Bell 2001). 'Photic headshaking', that is, headshaking triggered by light (Madigan *et al.* 1995), appears to be a popular explanation for the condition in the scientific literature, particularly in the USA where the study originated.

Bilateral infra-orbital neurectomy as a treatment for headshaking was first reported by Williams (1897) and since then by Mair *et al.* (1992), Cook (1980a), Mair *et al.* (1992) and Mair (1999). The technique involves sectioning the nerves, at the level of the superficially located infra-orbital foramen (see Fig. 1.1), to remove sensation to the muzzle area. Success of this procedure is usually reported in around 30–40% of cases (Mair and Lane 1990, Mayhew 1992, Mair *et al.* 1992, Mair 1999), but some of these may only be a temporary improvement. Complications include short-term nasal irritation, self mutilation due to lack of sensation in the muzzle and neuroma formation, which can be painful for the horse and exacerbate the headshaking (Mair 1999, Mayhew 1992). As a result, the technique is generally considered a salvage procedure by surgeons, only to be attempted following repeated successful temporary blocking of sensation to the nerve (Wilkins *et al.* 1993, Mayhew 1992). Successful infra-orbital neurectomy does not help us understand the cause of the irritation, only its likely location (Wilkins *et al.* 1993). It also does not seem to be a popular procedure with owners, for example, Madigan and Bell (2001) reported no cases in their survey of 109 horses.

Some authors have wondered if a location for any possible neuralgia may lie deeper in the head (Cook 1980a, Mair *et al.* 1992, Newton *et al.* 2000). This would explain unsuccessful neurectomies and nerve blocks at the level of the infra-orbital foramen. Newton *et al.* (2000) suggested that irritation within the nasal cavity (caused by neuralgia of more posterior nerves) would be more likely to explain snorting, flipping and naso-facial rubbing than peripheral muzzle irritation (caused by neuralgia of the infra-orbital nerve). They suggested that an increase in severity of headshaking with exercise could be explained by an increase in the blood supply to, and an increase in airflow, turbulence and volume of particulate matter in the nasal cavity which might irritate an already hypersensitive nerve. They reported success with anaesthesia of the posterior ethmoidal branches of the trigeminal nerve in 13 out of 17 horses, 11 of which improved by at least 90%. They likened the headshaking condition to trigeminal neuralgia (TgN) observed in humans (also known as Tic douloureux), and reported at least 80% improvement within 3–4 days treatment with a combination of cyproheptadine and carbemazepine (an anti-convulsant used to treat human TgN) in seven out of nine horses (Newton *et al.* 2000).

The underlying cause for the neuralgia or irritation of the nerves is still unknown. The same is true of many trigeminal neuralgias in humans although dental problems have been listed as causal factors (Roberts and Person 1979). The photic sneeze phenomenon is thought to be highly hereditary in humans (Everett 1964) and, if this is a cause of headshaking, it might explain the observed incidence of headshaking in thoroughbreds, which are considered to be inbred (Cook 1992). However, no genetic analysis of headshakers has been reported in the literature. Equine Herpes Virus (EHV1) has been suggested, since the herpes virus might lie dormant in the trigeminal ganglia and might be activated by physiological stressors (Madigan 1996). Cook (1998a) has recently suggested that the cause of the neuralgia in the horses could be the presence and use of the bit in the mouth when the horse is ridden. He postulated that pain created by the use of the bit would be felt in the diastema of the mandible, causing the horse to shake its head. Pain referred from the mandibular branch to other branches of the trigeminal nerve (the maxillary and ophthalmic) might explain the additional signs such as nose rubbing and snorting (Cook 2000, 2002, 2003). He suggested that this theory would explain the greater incidence in males since the root and nerves of the canine tooth lie close to the portion of the diastema upon which the bit presses (Cook 2003) (see Fig. 1.1). Since trigeminal neuralgia in humans is often triggered by chewing (Rasmussen 1991) the presence of the bit in the mouth might also trigger neuralgia in the horse indirectly (Cook pers. comm.).

Theories as to the aetiology of idiopathic headshaking have been largely supported by similarities in symptomatology between human conditions and the signs of equine headshaking rather than by response to treatment. Reported response to treatment for equine headshaking in the literature has been poor in general or varies from study to study. There are a number of reasons that might explain why this has been the case. Our knowledge of the effective mechanism of action (e.g. cyproheptadine), the optimal dosage (e.g. carbemazepine) and optimal route of administration (e.g. beclomethasone nasal spray and systemic dexamethasone) for many treatments is incomplete. As a result it is not known whether the treatment is reliably exerting an effect when it is possible. Secondly, the number of horses used in the studies has been very small. It has ranged from seven horses (cyproheptadine–Madigan *et al.* 1995) to 19 (infra-orbital neurectomy–Mair *et al.* 1992). Such small sample sizes often preclude statistical assessment of evidence. They also preclude any reliable predictions of the response in other horses based on the success of those in the trial. Reliance on a referral population in many studies may mean that the horses involved in the trial have a more severe or frustrating form of the disease which may not reflect that seen in the general headshaking population. As no controls or placebo treatments are used in the case reports it cannot be ruled out that the improvement might have occurred for reasons other than the treatment, for example spontaneous remission of signs due to a change in environmental conditions. There is obviously a need for more trials of other, potential treatments, involving a larger sample of horses and closer attention to the signs of the syndrome, so that testing for prognostic factors might be possible. Controlling for coincidental improvements through the use of placebo treatments is a vital part of evaluating the usefulness of treatments for headshaking, especially given the intermittent nature of its occurrence.

1.5 The reported success of alternative and complementary treatments

Mills *et al.* (2002b) reported that, although 75% of owners from their survey had reported that they had consulted a vet about their horse's headshaking problem, less than this (50%) reported that they had used a veterinary treatment. Of those who had tried veterinary interventions, only 28% reported that the treatment had been at least partially successful for the headshaking. Veterinary advice can vary from resting the horse (Cook 1980b) or moving it (Knottenbelt 1998) to re-training it (Mayhew 1992), none of which is often practical for the horse-owner (Knottenbelt 1998). Thus it seems that once no obvious pathology has been identified and available treatment has failed, owners are often left to cope with the problem on their own. Perhaps as a result, they seem to be seeking alternative or complementary treatments and/or management strategies with which to help their horse. Mills *et al.* (2002b) reported that the use of alternative therapies was popular amongst the owners responding to the survey and, in some cases apparently as helpful as conventional veterinary treatment. A total of 95% of the owners reported trying at least one of the following: homeopathy, feed supplements, consulting with back specialists, face, ear or nose nets and other alternatives. Notably, homeopathy was reported to have been at least partially effective in 38% of cases and feed supplements in 35% of cases. The range of therapies that have been attempted probably reflects our lack of understanding of the aetiology of the condition and the desperation of the owners. In the absence of any controlled studies of interventions such as these the reliability of these reports remains questionable.

The most successful preventative measure appears to be some kind of facial covering, most commonly a 'nose net'. This is a piece of net-like material placed over the muzzle to cover the nostrils, first suggested by Williams (1897). Mills *et al.* (2002b) found that a nose net was reported by owners to be at least partially successful at preventing headshaking attacks in 61% of horses that had worn one and completely successful in 27% of them. Slightly lower rates were reported for ear and face nets. A recent trial of three types of nose net reported similarly positive results (Mills and Taylor 2003). Improvement by at least 50% from their overall severity score at baseline was reported in 58-65% of horses, depending on the style of net used. Despite this, however, some veterinary surgeons report that nose nets are of limited use and that any benefit is only temporary (Newton *et al.* 2000). Mair *et al.* (1992) reported that only 3 out of 10 horses were at least slightly helped by a nose net.

Why covering the nose might be helpful to headshakers is a source of speculation. It has been suggested that a nose net might act via filtration of irritants (Ashton 1999), by altering airflow dynamics (Newton *et al.* 2000) or by acting as a counter-stimulant (Mills *et al.* 2002b). Newton *et al.* (2000) reported that headshaking in 78% of horses was reduced by at least 80% when wearing an occlusive mask which restricted airflow to a tube underneath the chin. They suggested that this mask might help by restricting airflow, turbulence and volume of particulate matter into the nasal cavity, preventing the triggering of any hypersensitive nerves. The success of a normal nose net relative to the occlusive mask might reflect a less efficient but nonetheless similar system. However, a different situation has been reported in the USA where covering the horse's eyes is reported to be more helpful than covering the nose (Madigan and Bell 2001). Blindfolding or the wearing of a face mask was reported in 75 horses and was reported to improve signs in 60% of them. Placing material over the horse's nose was reported in 45 horses but improved signs in only 33% of them.

Despite their apparent popularity, other alternative and complementary therapies such as feed supplements have not been properly evaluated for their effect on headshaking in controlled conditions. Therefore we cannot be confident of their claimed effect. A meeting of the Association of British Veterinary Acupuncturists (ABVA) recently concluded that acupuncture is unlikely to be effective and should no longer be recommended unless the source of the pain is thought to be musculoskeletal in origin (Scott 2001). Previous to this, acupuncture had been suggested as a possible complementary treatment by several authors (Mair and Lane 1990, Mayhew 1992, Bidstrup 1999). For other therapies, claims of their efficacy at reducing headshaking have largely been based on favourable owner reports (e.g. the bitless bridle, Cook 2003) or small trials that have not been controlled by placebo or randomisation. A homeopathic remedy 'Alleosal' (Biokanal, Germany) is being marketed for headshaking based on a trial of 11 horses, 9 of which were reported to improve (Prasse pers. comm.), although by how much and in what way has not been presented. Crucially, owners were also requested to undertake management changes such as soaking hay which may have had more impact on the headshaking than the homeopathic treatment.

There is therefore a need for controlled studies of the effectiveness of alternative therapies for headshaking, using measures for improvement that can be consistently interpreted by other researchers. Loosely termed improvement measures such as 'marked' and 'slight' (used in case reports e.g. Mair *et al.* 1992 and survey responses e.g. Mills *et al.* 2002b) do not provide information on how this relates to change in the horse's behaviour. Controlling for all improvements other than those attributable to the treatment is a vital part of assessing efficacy. Improvement may be reported for a number of reasons including:

1. The use of owners as the assessor of the horse's improvement.
2. Spontaneous improvement in the headshaking, often attributed to changes in environmental conditions (Newton *et al.* 2000, Mair *et al.* 1992).

The best method for controlling for these 'nuisance factors' is to compare the change in the horse following treatment relative to the change when the horse is given a placebo. To date, no treatments for headshaking have been controlled in this manner, and as a result, only conservative conclusions can be drawn regarding their specific efficacy. As a consequence, owners may not only be using ineffective and expensive treatments, but they may be using them in preference to conventional therapies that might be more effective. Given that some believe that headshakers are in considerable pain (Newton *et al.*, 2000) this is an important welfare problem to resolve.

1.6 Classification of headshakers

Given that headshaking is a behavioural sign indicative of many diseases (Mair and Lane 1990) it is surprising that there have been relatively few attempts to characterise headshakers according to their behaviour and history. At the moment it seems that every horse, whilst sharing similarities with others, can respond differently to a particular treatment and researchers do not generally take this into account. A careful description of the symptomatology of the condition in each case would not only allow the identification of signs that might be indicative of specific pathologies, but would enable discrimination amongst horses whose aetiology remains unknown based on their symptomatology and differential response to various treatments.

From the published reports of diagnoses made to date it is possible to identify some cases where the headshaking and associated signs were distinctly different from those of the idiopathic population described by Lane and Mair (1987). For example, ear rubbing and reluctance to accept manipulation of the ears seems to be associated with otitis media/interna (Blythe *et al.* 1990, Hassel *et al.* 1995). Similarly, horizontal headshaking and ear rubbing has been suggested as an indication of ear mites or otitis externa, although this has not been confirmed clinically in the literature (Mair and Lane 1990, Mayhew 1992). The presence of other neurological signs might indicate neurological pathologies such as equine protozoal myeloencephalitis, EPM (Moore *et al.* 1997–reported excessive sweating, twitching, trembling and gait abnormalities), cranial nerve dysfunction (Lane and Mair 1987–reported head tilt and facial paralysis) or temporohyoid osteoarthropathy, which can follow otitis media/interna (Blythe *et al.* 1990, Hassel *et al.* 1995–reported head tilting, ulceration of the cornea and facial paralysis). In addition, the season of the onset of the problem may also be significant. Onset of the headshaking in autumn rather than in spring was reported in horses with *Trombicula autumnalis* infestation of the false nostril (Mair 1994), EPM (Moore *et al.* 1997) and maxillary osteoma (Kold and Ostblom 1982).

Whilst examples like the above might be used to distinguish between known potential causes of headshaking and the idiopathic form, a more detailed investigation of the signs within the idiopathic condition may help identify horses with similar patterns of behaviour and onset (Mills *et al.* 2002a). From this it might be possible to suggest causes and then test treatments in relation to these types of headshaker. For example, a careful look at the signs and triggers of the horse might help identify the likely source of the irritation. Newton *et al.* (2000) suggested that neuralgia in the nerves supplying sensation to the nasal cavity would be more likely to produce snorting and facial rubbing than a more peripheral hypersensitivity. There has also been a recent suggestion that some headshakers might be suffering from post herpetic neuralgia which presents itself as general peripheral hypersensitivity to touch and wind that is less spasmodic than trigeminal neuralgia (von Schweinitiz, cited by Scott 2001). Without a clearer record of the presentation of the signs in a large sample of headshakers it is not possible to describe how to distinguish among horses affected by these different forms of irritation, if indeed they exist. Differentiation has recently been attempted by Mills *et al.* (2002a). Using principal component analysis, 11 behavioural signs were reduced to five components that explained over 60% of the variation in the data. However, there is no straightforward interpretation of the components. The use of a wider range of signs and inclusion of other factors may make this process easier (as would grouping some signs that are perhaps measuring the same phenomenon e.g. rubbing the nose on the ground whilst moving might be considered the same phenomenon as rubbing the nose on the ground whilst stationary).

Based on the occurrence of the problem and response to treatment, Mayhew (1992) attempted to classify headshakers into three categories; persistent, seasonal and obsessive. He suggested that persistent headshakers have a clinical or sub-clinical cause such as guttural pouch mycosis or ear mites and seasonal headshakers may be suffering from allergic or vasomotor rhinitis. Obsessive headshakers do not have a seasonal pattern and may be suffering from some kind of obsessive-compulsive disorder. Although a useful place to start, Mayhew's categorisation is complicated by the fact that many non-seasonal headshakers used to be seasonal (Newton *et al.* 2000, Lane and Mair 1987, Mills *et al.* 2002a). In addition Mayhew offered no description of the behaviour that would discriminate between persistent headshakers (where the cause has been missed or not yet known) and obsessive headshakers.

1.7 Summary

Headshaking appears to be a recognised problem for horses and their owners in many areas of the world. Until recently the majority of scientific literature regarding headshaking has been limited to isolated case studies involving one or two horses, expert opinion or reviews of these papers. Many of the horses that currently present to the veterinary surgeon remain idiopathic and are not reported to respond well to a range of veterinary interventions. Most clinicians agree that the signs of idiopathic headshaking syndrome are indicative of mild to severe pain in the head area and suggestions as to the possible aetiology include neuralgia and rhinitis. It is unlikely that the syndrome has a single cause, however, but, despite this assumption, there have been few attempts to describe the variation in symptomatology within the headshaking population in relation to aetiology or response to treatment. This may be due to the lack of suitably sized, controlled trials of successful treatments and inconsistent reporting of the presentation of the syndrome. Subsequent advice and treatment offered to owners can vary and many may be resorting to the use of alternative therapies without veterinary supervision. Despite the apparent popularity of these, there has been a lack of controlled studies of their efficacy at preventing or treating the signs of headshaking. It remains possible therefore that coincidental remission in signs during their use has led to unfounded causal associations by the owner.

The aim of this work is to evaluate equine headshaking syndrome in terms of its reported presentation and response to treatment. As a result, the thesis is presented in four parts. The first part describes the use of a case-control survey to investigate the prevalence of health and management factors implicated in the literature between headshakers and horses without this problem. The second part of the thesis presents the results from a large survey adapted from Mills *et al.* (2002a). This describes the headshaking syndrome as it is reported in a large sample of horses described as 'headshakers' by their owners. The detail to which the survey goes into allows multivariate techniques to be employed to attempt to differentiate amongst the horses based on their symptomatology and reported response to treatment. Since owners are relied upon for information about their horse in this and other studies, the third part of the thesis looks at the consistency of owners as assessors of their horse's behaviour. The consistency within- and between-owners with regard to their reports of the presence of headshaking signs is evaluated in a video observation exercise. The consistency of their reports in two surveys completed two years apart is also compared and the implications for the prognosis of the condition are discussed. Given the apparent variability for the headshaking, the reliability of a single observation of the headshaking is also evaluated.

Since some management aids might be as specific in their mode of action as conventional therapies they have the potential to be important tools to differentiate between headshakers. However, their efficacy needs to be properly evaluated with a valid methodology, including the use of controls where possible. An appropriate methodology for the assessment of management aids for the prevention and treatment of headshaking syndrome is described in the final apart of the thesis, drawing from conventional, scientific clinical trial methodology. Difficulties in the assessment of the headshaking syndrome and how some of these can be overcome by the use of the owners as intermediary reporting agents will be discussed. The results from four trials, conducted using this methodology, are also presented in this section. The implications of the results will be discussed and recommendations made for future studies.

Chapter 2

Part I

A case-control study investigating health, management and behavioural features of horses described as headshakers

(Results published as Taylor *et al.* 2001)

2.1 Introduction

As the aetiology of idiopathic equine headshaking still remains to be confirmed, opinions vary regarding the importance of various risk factors. It has been suggested, for example, that headshakers are more likely to have immune-mediated problems such as chronic obstructive pulmonary disease (COPD) or non-respiratory allergies such as urticaria (Mair and Lane 1990). This assertion was supported by a significant proportion of horses in the survey by Lane and Mair (1987) showing signs of lower airway inflammation in addition to the headshaking problem. It has also been suggested that factors such as management, stabling and diet may play a role in exacerbating the condition (Cook 1980b). For example, the problem may be exaggerated by over-exuberance in horses that are highly-fed and under-exercised (Williams 1897, Cook 1980b), or in horses that are reacting to excessive levels of sugar in the diet or some other dietary intolerance (Cook 1980b). Cook also suggested that type of use, specifically the disciplines of dressage and show jumping, might be a risk factor as, in his experience, most headshakers were horses used primarily for these (Cook 1992). He postulated that the characteristic head carriage of the horse in these forms of equitation might cause respiratory distress and/or cervical pain and headshaking as a response to this.

Putative risk factors such as these have largely been conjectured via an accumulation of patterns in case reports. This does not allow for the possibility that the prevalence of these factors may be similar in horses without a headshaking problem. They have therefore remained unsubstantiated by the lack of specific epidemiological study. Only a study of the prevalence of certain putative risk factors, in both a sample of headshaker and un-affected horses, will indicate whether a factor is likely to be over-represented in one population compared to the other. The case-control study is an epidemiological technique that has not been used extensively to study the headshaking problem. This type of study looks at reported prevalence of factors in affected subjects (the case–i.e. headshakers) and compares it to similar subjects without the problem (the control–i.e. horses without a headshaking problem). Each case is paired with a control and differences between the pairs for each factor are compared. This is also known as the matched-pairs study (Pocock 1991).

A case-control study can establish whether headshakers are likely to be over-represented with the management and health factors that have been mentioned in the literature in association with headshaking. In addition to these factors, a comparison of the health care history between case and control might highlight practices that headshakers as a group are less (e.g. dental inspection) or more (e.g. alternative therapies) likely to receive. Mills *et al.* (2002b) reported that the use of alternative therapies by owners of headshakers was considerable (e.g. 38% of owners reported trying homeopathy) and it would be of interest to see if the use of these is equally common amongst the general horse population. Finally, the reporting of behavioural signs that have been associated with the headshaking syndrome can also be compared between case and control. In this way, information regarding the relative prevalence of these signs in 'normal' horses will be gained, making a discussion regarding what constitutes a 'headshaker' more sound.

2.2 Aim

1. To test the null hypothesis that there is no difference between horses that are reported to have a headshaking problem and those that are not with regards to their reported:
    a. type of equitation
    b. stabling routine and bedding type
    c. diet
    d. prevalence of COPD, other respiratory problems and other allergies
    e. health care experience
    f. presentation of typical headshaking signs.

2.3 Methods

2.3.1 Design of the case-control survey

A case-control study was designed to compare specific management details between horses reported to be headshakers by their owners and similar horses without this problem. A survey was used to collect information from the owner regarding a range of factors that had featured in the veterinary literature in association with headshaking.

Factors compared between headshaking and normal horses were:

- Management of the horse (typical pursuits used for, workload, stabling routine, type of bedding and diet (types of food)). Questions were adapted from a list given in Cook (1979b) that might be pertinent to the headshaking problem.
- Associated health problems (reported presence of COPD, other respiratory problems and other allergies), in response to the assertion in Mair and Lane (1990) that headshakers may be more likely to suffer from these.
- Health care (regularity of worming and dental inspections, removal of whiskers and past experience of veterinary treatment, the use of homeopathy, back specialists and other alternative therapies). These questions featured in the survey described by Mills *et al.* (2002b) and it was of interest to compare the use of these between headshakers and horses without this problem.
- Headshaking signs (the reported presence of 12 listed signs; *headshaking at rest, headshaking with exercise, headshaking when excited, horizontal headshaking, vertical headshaking, rubbing the nose on objects, flipping the nose, acting like a bee flew up the nose, sneezing or snorting, striking at the nose* and *rubbing the nose on the ground-when moving* and *when stationary*). These signs featured in the survey described by Mills *et al.* (2002a) and are generally considered to be signs that a 'headshaker' will typically present with.

The survey described in Mills *et al.* (2002a and b) already covered the questions listed above and was therefore was used as the 'case'. An adapted survey regarding a horse without a headshaking problem was completed by the owner of each headshaker in the survey as the 'control'. For this, 198 owners of headshakers who had already recently participated in the National Equine Headshaking Survey (NEHS) (Mills *et al.* 2002a) were approached by post with a request to complete an adapted version of the survey questionnaire regarding a horse that was not considered by the owner to be a headshaker. See Appendix I for a copy of the adapted questionnaire. Owners were requested to choose this 'control' horse on the basis of its similar physical attributes (age and type) and its geographical proximity to the problem horse. The breed, sex, age and height of the horse together with the size of its yard and type of locality were recorded, so that the extent of the match between horse pairs could be assessed.

2.3.2 Analysis of results

For each question in the survey the response for the case (headshaker) was compared to its matched control (horse without a headshaking problem from the same yard). The hypothesis that there was no disagreement between the horse pairs was tested using McNemar's test of association, Q_M (Agresti 1990). This test only looks at the differences in counts of discordant pairs (i.e. horse pairs in disagreement, shaded cells) compared to the counts of concordant pairs (i.e. horse pairs in agreement, un-shaded cells) in a two by two table for example:

Question 1.	**Control**	
Case	*Yes*	*No*
Yes	n_{11}	n_{12}
No	n_{21}	n_{22}

McNemar's statistic, Q_M, is written as $$Q_M = \frac{(n_{12} - n_{21})^2}{(n_{12} + n_{21})}$$

This statistic has an approximate chi-square distribution with one degree of freedom.

Where 25% of the paired response options (e.g. one cell in a two by two table) had an expected count of five or less, the exact p-value was given (Stokes *et al*. 1995). Bowker's test for symmetry, Q_B, was used for questions with more than two response categories (Stokes *et al*. 1995). The degrees of freedom for this statistic were R(R–1)/2, where R = the number of response categories. For ordinal variables, the differences between pairs (headshakers–controls) were compared using the Wilcoxon signed-rank test.

2.4 Results

2.4.1 Horse details & matching

83 headshakers were successfully paired with another horse that was not considered by its owner to be a headshaker. This gave a response rate of 42% out of the 198 owners contacted with regards to the study. There were no significant differences between the two groups of horses with respect to sex, breed, height, locality and the size of their yard ($p>0.1$), see Table 2.1. However, there was a significant difference between the horse pairs with regard to age, with the headshakers being on average about one year younger than the controls (Wilcoxon signed rank, $Z = -2.35$, N for test = 81, $p = 0.019$, mean difference = –1 year).

Table 2.1. The characteristics of the horses in the survey and the statistical significance of the difference between the groups, $N = 83$ in each group.

	Headshakers	Controls	Test result
Sex	50 geldings (60%) 33 mares (40%)	54 geldings (65%) 29 mares (35%)	$Q_M = 0.50$ DF = 1 p = 0.480
Breed	24 TBs (29%) 9 Cobs (11%) 12 Ponies (14%) 5 Warmbloods (6%) 33 Others (40%)	20 TBs (24%) 6 Cobs (7%) 17 Ponies (20%) 2 Warmbloods (2%) 38 Others (46%)	$Q_B = 6.34$ DF = 10 p = 0.786
Age	Mean: 11.50 years SD: 5.1, (Median: 10.0) Range: 4.50–28.75	Mean: 12.75 years SD: 5.9, (Median: 11.5) Range: 3.50–29.00	W-signed rank $Z = -2.35$ N (test) = 81 p = 0.019
Height	Mean: 15.25 hands S.D: 1.0, (Median: 15.5) Range: 12.50–17.50	Mean: 15.25 hands S.D: 1.4, (Median: 15.5) Range: 9.25–17.75	W-signed rank Z = –0.08 N (test) = 70 p = 0.940
Size of Yard	Mean: 9.5 horses S.D: 11.4, (Median: 5) Range: 1–70	Mean: 9.2 horses S.D: 11.3, (Median: 5) Range: 1–70	W-signed rank $Z = 0.80$ N (test) = 52 P = 0.424
Locality	78 rural (94%) 4 rural/urban (6%)	77 rural (93%) 5 rural/urban (7%)	$Q_M = 0.14$ DF = 1 Exact p = 1.000

2.4.2 Management of the horse

2.4.2.1 Pursuits

Owners were requested to specify all the pursuits for which their horses were used. 64% of all the horses were used for hacking out and there was a significant difference between the two groups with respect to this (p = 0.012). 60 control horses (72%) were used for hacking compared to 47 (57%) of the headshakers, see Table 2.2. The next most popular pursuits were dressage (27% of all horses), jumping (25%) and eventing (21%) and there were no significant differences between the horse pairs with respect to each (p>0.05). Other pursuits included attending riding clubs (16%), hunting (11%), showing (9%), driving (5%), schooling (5%), endurance (3%), hunter trials (3%), other (8%) and not being ridden (1%). There were no significant differences between the pairs with respect to each of these less common pursuits (exact p>0.1).

Table 2.2. The number of headshaker (H) and control (C) horse pairs participating in the pursuits of hacking out, dressage, jumping and eventing, (*N*=83). The number of pairs that disagreed for each pursuit are shown in the shaded columns. McNemar's test statistic, Q_M and evaluative probability, p are shown in the far right columns.

Use	H (yes) C (yes)	H (yes) C (no)	H (no) C (yes)	H (no) C (no)	Q_M	p
Hacking	40	7	20	16	6.26	0.012
Dressage	11	13	10	49	0.39	0.532
Jumping	6	19	11	47	2.13	0.144
Eventing	6	13	10	54	0.39	0.532

There was no significant difference between the groups for the total number of uses for each horse ($Q_B = 3.62$, DF = 6, p = 0.728), with the majority of horses in both groups reported to be used for one or two pursuits. (Possible categories were; 1, 2, 3 or 4 or more pursuits, i.e. 4 categories). There was no significant difference between the pairs in the amount of weekly work undertaken ($Q_B = 5.39$, DF = 6, p = 0.495), with the majority of all horses (78%) reported to be worked at least 3 days a week. (Possible categories were; less than once a week, 1–2 days per week, 3–5 days a week or every day, i.e. 4 categories).

2.4.2.2 Stabling routine and bedding type

There were no significant differences between the pairs with regard to living arrangements, with the majority of all horses (86%) having a mixed strategy of living inside and outside depending on the time of day and season ($Q_B = 2.33$, DF = 3, p = 0.506). (Possible categories were; stabled all the time, outside all the time or a mixed strategy, i.e. 3 categories).

There was no significant difference in bedding type ($Q_B = 8.67$, DF = 10, p = 0.564). The most popular bedding type was straw (42% of all horses) and wood shavings (40%). (Possible categories were; straw–including treated or chopped, sawdust, paper, wood shavings or other, i.e. 5 categories).

2.4.2.3 Diet

The range of food types and the prevalence of their feeding is shown in Table 2.3. The headshaking group were more likely to receive herbal supplements (37% of the headshakers, 18% of the controls; $Q_M = 9.85$, p = 0.002) There was a tendency for headshakers to be given more fruit (14% of the headshakers, 5% of the controls; $Q_M = 4.57$, exact p = 0.057), but less likely to receive mixed concentrated feed supplement (55% of the headshakers, 67% of the controls; $Q_M = 3.57$, p = 0.059), see Table 2.3.

Table 2.3. The number of headshaker (H) and control (C) horse pairs fed the following type of feed as part of their normal diet (N=83). The number of pairs that disagreed for each food type is shown in the shaded columns. McNemar's test statistic, Q_M and evaluative probability, p, (exact) are shown in the far right columns.

Food type	H (yes) C (yes)	H (yes) C (no)	H (no) C (yes)	H (no) C (no)	Q_M	P
Grass	75	5	3	0	0.50	(0.727)
Hay	68	7	5	3	0.33	(0.774)
Chopped straw	38	17	10	18	1.82	0.178
Mixed concentrates	37	9	19	18	3.57	0.059
Sugar beet	34	12	11	26	0.04	0.835
Vitamin supplements	15	13	21	34	1.88	0.170
Pony nuts	19	12	12	40	0.00	1.000
Herbal supplements	10	21	5	47	9.85	0.002
Ensiled hay	7	7	5	64	0.05	(1.000)
Cereals	7	7	5	64	0.33	(0.774)
Fruit	1	11	3	68	4.57	(0.057)
Probiotics	3	6	5	70	0.09	(1.000)
Other	2	8	8	65	0.00	(1.000)

There were no other significant differences between the two groups for any of the other food types listed ($p>0.1$). Overall, 95% of all subjects were reported to be provided with fresh grass and 89% with hay. 62% were fed chopped straw, 61% mixed concentrated feed supplement, 55% sugar beet, 39% vitamin supplements, 37% pony nuts (cereal based feed supplement) and 28% herbal supplements. The feeding of ensiled hay (20%), cereals (16%), fruit (10%), probiotics (live microbial feed supplement, 9%) and other types of feed (12%) was less common.

There were no significant differences between the pairs with regard to the total number of foods given to each horse (Wilcoxon signed rank test; $Z = 1.18$, N for test = 65, $p = 0.237$). The headshaker group were fed a mean of 5.6 food types (median 6, SD: 1.41, range 3–10) and the controls 5.2 (median 5, SD: 1.52, range 2–10).

2.4.3 Associated health problems

On average, 5% of all the horses were reported by their owners to have COPD, 9% other respiratory problems and 9% other allergies. Twice as many headshakers as control horses were reported to have 'other respiratory problems' or 'other allergies' but the proportion of pairs that disagreed on these factors was not statistically significant, $p>0.1$, see Table 2.4.

Table 2.4. The number of headshaker (H) and control (C) horse pairs reported to suffer from COPD, respiratory problems and other allergies (N=83). The number of pairs that disagreed for each treatment type is shown in the shaded columns. McNemar's test statistic, Q_M and evaluative probability, p, (exact) are shown in the far right columns.

Problem	H (yes) C (yes)	H (yes) C (no)	H (no) C (yes)	H (no) C (no)	Q_M	p
COPD	3	1	2	77	0.33	(1.000)
Other respiratory problems	0	10	5	68	1.67	(0.302)
Allergies	2	11	4	66	3.27	(0.119)

2.4.4 Health care

There was no significant difference between the pairs with regards to the frequency of worming ($Q_B = 9.05$, DF = 6, p = 0.171), with the 54% of all horses being reported to be wormed every 5–8 weeks and 39% every 9–12 weeks. (Possible categories were; monthly, every 5–8 weeks, every 9–12 weeks or less than every 12 weeks, i.e. 4 categories).

There was no significant difference between the pairs with regards to the reported frequency of dental inspection ($Q_B = 7.33$, DF = 6, p = 0.291). The majority of owners (87%) reported that their horse's teeth were inspected at least annually. (Possible categories were; twice yearly, yearly, every 1–2 years or less than this, i.e. 4 categories).

There was no difference between the pairs with regards to removal of whiskers, which was practised by roughly 25% of all owners ($Q_M = 0.80$, p = 0.371).

Overall, the majority of horses (73%) were reported to have been treated by a veterinary surgeon at some point in their lives. 38% of owners also reported the use of back specialists, 29% the use of homeopathy and 13% other alternative treatments for their horse. The headshaking group were significantly more likely than control horses to report the use of each of these treatment types, see Table 2.5.

For conditions *other than headshaking,* owners of headshakers were significantly more likely to report that they had sought the assistance of back specialists ($Q_M = 6.26$, p = 0.012) and homeopathy ($Q_M = 5.56$, p = 0.018) for their horse. The results are presented for clarity in Fig.2.1.

Table 2.5. The number of headshaker (H) and control (C) horse owner pairs that reported that they had sought treatment from a veterinary surgeon, a back specialist, used homeopathy or any other alternative treatment for their horse (in general, and for problems other than headshaking) (*N*=83). The number of pairs that disagreed for each treatment type are shown in the shaded columns. McNemar's test statistic, Q_M and evaluative probability, p, (exact) are shown in the far right columns.

Treatment type	H (yes) C (yes)	H (yes) C (no)	H (no) C (yes)	H (no) C (no)	Q_M	p
In general:						
Veterinary surgeon	44	23	10	6	5.12	0.024
Back specialist	16	25	4	38	15.21	<0.001
Homeopathy	5	37	1	40	34.11	(<0.001)
Other alternatives	3	13	2	65	8.07	(0.007)
Not for the headshaking problem:						
Veterinary surgeon	34	16	20	13	0.44	0.505
Back specialist	13	20	7	43	6.26	0.012
Homeopathy	2	14	4	63	5.56	(0.031)
Other alternatives	0	5	5	73	0.00	(1.000)

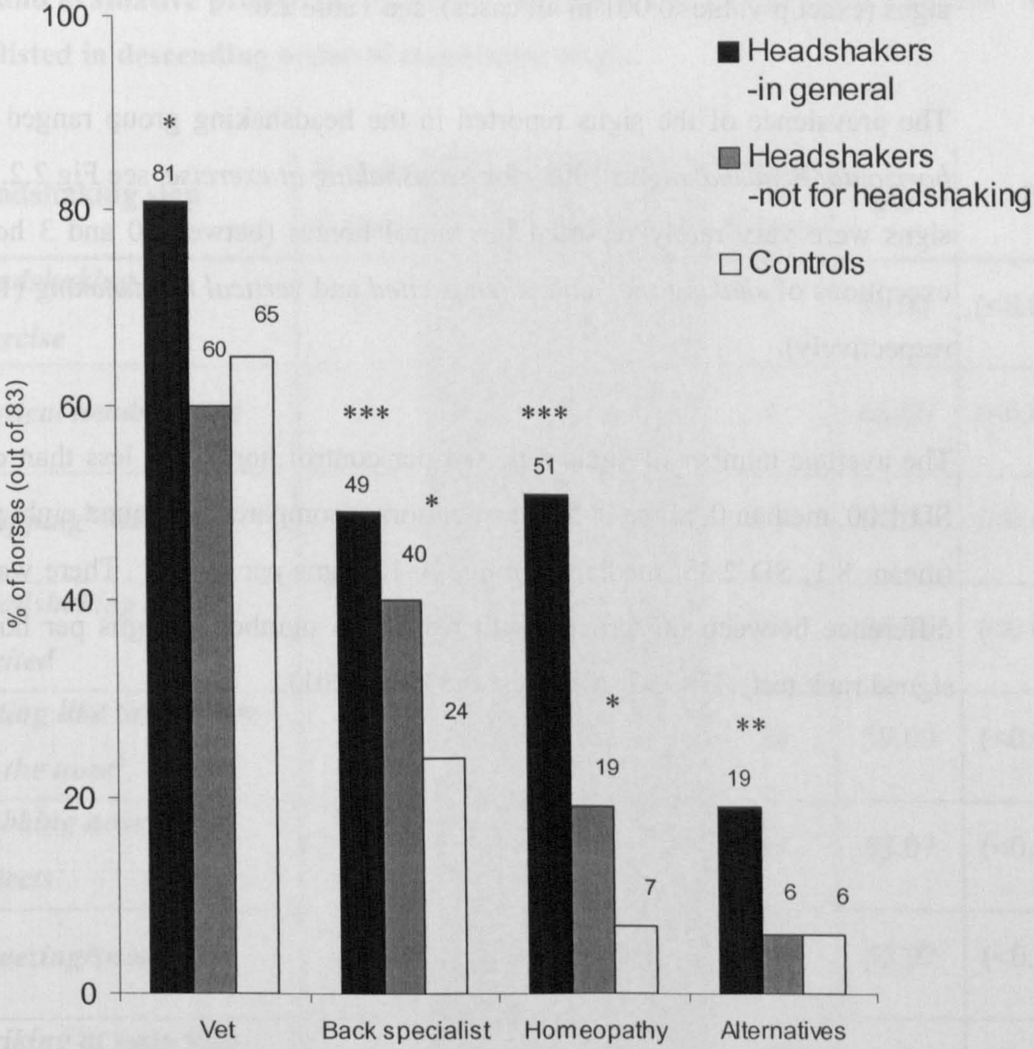

Fig. 2.1. The percentage of headshakers and controls (*N*= 83) that were reported to have been treated by a veterinary surgeon, back specialist, homeopathy or other alternative treatment. Values above each bar represent the percentage of horses in that category, asterisks indicate the degree of significance of the difference from the control group, * p<0.05, ** p<0.01, *** p<0.001.

2.4.5 Headshaking signs

Headshakers were significantly more likely to be reported with each of the 12 listed signs (exact p-value<0.001 in all cases), see Table 2.6.

The prevalence of the signs reported in the headshaking group ranged from 25% for *horizontal headshaking* to 100% for *headshaking at exercise,* see Fig 2.2. Most of these signs were very rarely reported in control horses (between 0 and 3 horses) with the exceptions of *shaking the head when excited* and *vertical headshaking* (11 and 8 horses respectively).

The average number of signs reported per control horse was less than one (mean 0.4, SD 1.00, median 0, range 0–5 signs per horse) compared to around eight per headshaker (mean: 8.1, SD 2.35, median 8, range 4–12 signs per horse). There was a significant difference between the groups with respect to number of signs per horse (Wilcoxon signed rank test, $Z = 7.92$, N for test = 83, $p<0.001$).

Table 2.6. The number of headshaker (H) and control (C) horse pairs reported to show various headshaking signs (N=83). The number of owner pairs that disagreed for each sign is shown in the shaded columns. McNemar's test statistic, Q_M and evaluative probability, p, (exact) are shown in the far right columns. Signs are listed in descending order of magnitude of Q_M.

Headshaking sign	H (yes) C (yes)	H (yes) C (no)	H (no) C (yes)	H (no) C (no)	Q_M	P
Headshaking at exercise	1	81	0	1	81.00	(<0.001)
Vertical headshaking	7	71	1	4	68.06	(<0.001)
'Flipping' the nose	1	68	1	13	65.06	(<0.001)
Headshaking when excited	10	63	1	9	60.06	(<0.001)
Acting like 'a bee flew up the nose'	0	59	0	24	59.00	(<0.001)
Rubbing nose on objects	2	61	1	18	58.07	(<0.001)
Sneezing/snorting	0	58	1	24	55.07	(<0.001)
Striking at nose with foreleg	1	51	1	30	48.08	(<0.001)
Headshaking at rest	1	43	0	38	43.00	(<0.001)
Rubbing nose on ground (when stationary)	0	43	1	39	40.09	(<0.001)
Rubbing nose on ground (when moving)	1	36	1	45	33.11	(<0.001)
Horizontal headshaking	2	19	1	61	16.20	(<0.001)

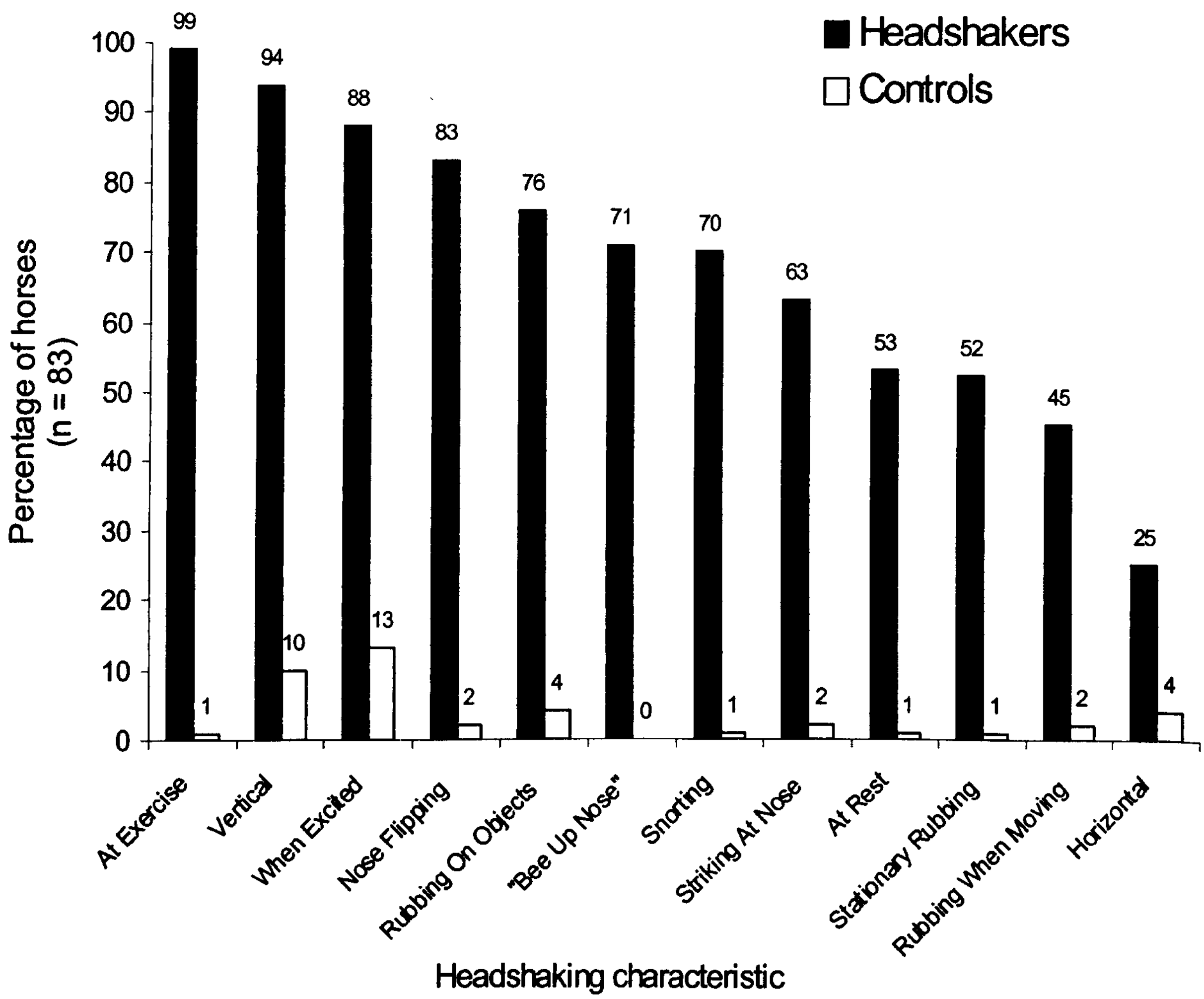

Fig. 2.2. The percentage of headshakers and controls (N=83) that were reported with various headshaking signs. Values above each bar represent the percentage of horses reported with that sign. There was a significant difference between the two groups for all signs; exact p<0.001.

2.5 Discussion

Retrospective case control surveys are an important epidemiological tool used to investigate diseases about which little is known, as they can highlight risk factors worthy of further investigation. They can be used to determine whether the diseased group (the case) and the non-diseased group (the control) differ in the proportion of those who have been exposed to a specific agent, risk factor or pathogen (Timmreck 1994). However, such studies do not distinguish between cause and effect and further work is necessary before a definite connection between factors and increased risk of contracting the disease can be established. Case control studies have proved to be very helpful in narrowing down the likely risk factors for other equine health problems, for example colic (Hillyer *et al.* 2002).

To date, risk factors for headshaking have been suggested based on their apparent frequency in case series or from individual expert opinion. For example, Cook (1992) suggested that the pursuits of dressage and show jumping may lead to headshaking as an avoidance of excessive poll flexion or cervical pain. However, the case-control study described here provides no evidence for an association between headshaking and the practice of dressage or jumping. This is in agreement with reports by Lane and Mair (1987) and Newton *et al.* (2000). However, the relatively small sample size and reliance on the owners for assessment has resulted in a sample population consisting mainly of privately-owned, general-purpose horses. This may preclude the assessment of the significance of specific competitive uses such as dressage, show jumping or racing. The association found between headshaking and not being hacked out may reflect owners of headshakers being wary of this activity given the unpredictability of the behaviour in many cases. Alternatively, it may reflect an association between uses other than hacking (i.e. partaking in amateur competition) and headshaking, although there was no significant difference in proportion of headshakers and controls for the individual pursuits. Amateur competition may be more likely to involve more severe use of the bit than hacking out, and severe use of the bit has been postulated as a cause of headshaking (Cook 1999).

This study found no evidence of an association between headshaking and workload, bedding type or general stabling routine. There was also little evidence for any difference in diet between headshakers and 'normal' horses, although headshakers might be more likely to be fed fruit and less likely to be fed mixed concentrated feed supplements. However, given the number of tests performed in this category, associations approaching significance are likely to have occurred by chance. Any differences between the pairs with regard to diet (or indeed other factors) may also reflect a change made in response to the onset of the condition, rather than a cause of the problem. Nonetheless, since the horses were considered headshakers at the time of the questionnaire, a proximate association between these management factors and headshaking does not appear to exist.

Removal of the facial whiskers is a cosmetic procedure that has also been suggested to help headshakers affected by the sensation of cold wind transmitted by these (Ween *et al.* 1926) or in order to make the nose net more comfortable for the horse (Mills *et al.* 2002b). However, no difference was found between the pairs of horses with respect to this practice, nor was any significant difference found with regard to the reported frequency of dental inspection or worming. Overlooked dental problems have been blamed for the cause of headshaking (Halls, pers. comm.), although such cases have not been reported in the literature. Irregular dental inspection *per se* and therefore an increased risk of overlooking such a problem does not seem to be over-represented amongst headshakers. Nearly three-quarters of all the horses were reported to have been treated by a veterinary surgeon at some point in their lives, which is similar, if slightly lower than that reported by Mellor *et al.* (2001) in their survey of horses in the north of the United Kingdom (85% were reported to have been treated by a veterinary surgeon). Once treatment by the veterinary surgeon specifically for the headshaking problem had been controlled for, horses with the problem were neither more nor less likely than horses without the problem to have had attention from a veterinary surgeon throughout their lives. This might therefore suggest that headshakers are neither more sickly animals with other medical problems than the general population nor horses lacking veterinary attention.

The increased prevalence of the use of alternative therapies amongst the owners of headshakers may reflect their frustration with conventional treatments for the condition, a situation that is commonly reported (Lane and Mair 1987). These owners are therefore seeking alternative therapies which they can apply themselves and are possibly using them for other conditions as a result. This is interesting since the efficacy of such treatments remains to be established scientifically, not only for the treatment of the headshaking condition but for many other equine ailments.

The headshaking group were no more likely to be reported to have COPD or other respiratory problems than the control group. If reports of COPD and other respiratory problems are combined as possible indications of clinical airway inflammation, the reported prevalence of these in headshakers (17%) and controls (12%) is much lower than that reported by Lane and Mair (1987) who found clinical signs of lower airway inflammation in approximately 60% of those headshakers that they examined. Mellor *et al.* (2001) reported a prevalence of COPD in their survey of horses in Northern Britain of 4%, which is similar to the findings of this study. Since the size of this study is comparably small for studies of this nature, and owners have been used as assessors of their horse, this does not rule out the possibility of an association between headshaking and respiratory problems or other allergies, but it does not appear to be a major factor. It is worth noting that Marti *et al.* (1992) found no correlation within equine families of one allergic condition (hypersensitivity bronchitis) with another (insect-bite hypersensitivity) and concluded that these allergic conditions were independent entities. The same may be true of an allergic cause of headshaking and other allergic conditions.

Horses not considered to be headshakers by their owners were very rarely reported to show any of the 12 headshaking signs listed in the survey. The most frequently reported behaviour by the control horses was *shaking the head when excited,* but was only reported in 13% of these. *Headshaking at rest*, which might be confused with 'nodding' (Cooper *et al.* 2000), was only reported in one control horse but was reported in approximately half the headshakers. This suggests that the signs associated with headshaking syndrome are rarely confused with the behaviour of horses that are not considered to have this problem.

Chapter 3

Part II

A survey of 200 UK headshakers:

1. Owner reports of occurrence, progression and response to treatment

3.1 Introduction

Lane and Mair (1987) conducted the first large-scale survey of horses presented to a veterinary surgeon for the investigation of headshaking. The authors identified common signs and patterns of occurrence within these horses and, in the absence of any other apparent disease process, suggested that many might be suffering from allergic rhinitis. Since this time we have not come much closer to understanding the cause of the problem in the majority of horses that present in the manner described by Lane and Mair. In an attempt to rectify this situation, another, more detailed survey was conducted by Mills *et al.* (2002a), which is the largest published survey of horses considered to have a headshaking problem to date. Their survey provided more detailed information on the reported seasonality of the condition, the prevalence of several clinical signs and the reported response to conventional and non-conventional treatments, which had only been touched upon by Lane and Mair (1987).

However, several of the areas in the survey by Mills *et al.* (2002a) were covered by open-ended questions, which did not make allowance for estimation of the reported prevalence of each factor in the survey sample. For example, many of the owners were able to describe a pattern to their horse's headshaking over the year, but a record of the variation in the occurrence and severity of the headshaking over the months of the year was not possible for all horses. This information is important to obtain because it would allow the categorisation of horses by the reported seasonal pattern to their headshaking. For example, allergic rhinitis in humans has been categorised as seasonal, perennial with seasonal exacerbations and perennial (Sibbald and Rink 1991). It would be interesting to establish if headshakers could be categorised according to these types and to compare the proportion of each to those reported in human allergic rhinitis. Categorisation of the horses by seasonality would also allow the testing of some of the hypotheses relating to the condition. For example, Cook (1992) suggested that the apparent seasonality of the condition in many horses might be a reflection of the seasonality in their workload. Knottenbelt (1998) has suggested that headshakers tend to deteriorate following the onset of the condition. There have been, for example, cases reported of seasonal headshakers deteriorating to become year round headshakers (Lane and Mair 1987, Newton *et al.* 2000). However, without knowledge of the reported progression of the disease over time the prognosis for headshakers in general remains unknown.

Other potentially significant factors were mentioned by the owners in open-ended sections of the survey by Mills *et al.* (2002a), such as an increase in workload or a change in location of the horse prior to onset of the condition. Without an idea of the prevalence of these factors in a sample of headshakers their significance cannot be appreciated. Owners frequently make associations with changes in the severity of the headshaking and local environmental conditions (Lane and Mair 1987, Mills *et al.* 2002a). The reported effect of six weather conditions on the headshaking was listed in the latter survey. However, comments by the owners (e.g. riding through a cloud of flies, pers obs.) and reports by authors (e.g. sharp sounds, Madigan, cited by MacDonnell 1998) suggest that others may also be worthy of investigation. A more comprehensive record of potential triggers may indicate the relative reported significance of the triggers and provide pointers for future research.

It is well-established that headshaking can have a deleterious effect on the relationship between horse and rider, sometimes resulting in relinquishment of the horse (Lane and Mair 1987). However, the extent and manner in which the behaviour impacts on the owner in general has not been documented. Many owners appear look to complementary and alternative therapies in order to help their horse (Mills *et al.* 2002b, Chapter 2). More detailed information regarding the reported success of such treatments might highlight treatments that are worthy of more rigorous evaluation in the future.

3.2 Aims

The aim was to survey a sample of British horses that are considered by their owners to have a headshaking problem in order to:

1. quantify the reported severity of the problem
2. quantify its effect on the use of the horse
3. to gather more detailed information regarding the reported:
    a. onset of the problem (owner awareness of the problem prior to onset, age of the horse at onset, month of onset, other events prior to onset)
    b. seasonality of headshaking signs (occurrence and severity)
    c. progression of the problem over time (changes in month of onset, seasonality, occurrence and severity since onset and the previous year)
    d. the reported effect of various environmental situations on the severity of the headshaking
    e. the reported success of conventional and non-conventional treatments
4. to test the null hypothesis that:
    a. there is no association between increased severity of the headshaking over the summer and an increased workload over the summer
    b. headshakers are not reported to deteriorate over time (for example, there is no change in the month of reappearance of signs since onset for seasonal headshakers)

3.3 Methods

3.3.1 Questionnaire design and recruitment

A similar postal survey to that described in Mills *et al.* (2002)–referred to as Q1998–was designed. Substantial modifications to this original survey were made in order to elaborate on certain points and to replace numerous open questions with closed ones. In particular, the range of behavioural signs was increased from 9 to 26 and the owners were asked to specify in which situation (when stabled, when grazing, whilst being ridden and after being ridden) each of these occurred. The results from these are discussed in Chapter 5. The range of situations that might have a reported effect on the headshaking was also increased from 6 to 17. A list of the changes from the Q1998 survey is provided in Appendix II.

A pilot of the questionnaire was sent to 12 owners on the NEHS database for completion and comments in May 2000. These responses were not included in the final results. Based on their replies, several new questions were added and some were rephrased. See Appendix III for a copy of the final questionnaire, referred to as Q2000.

Subjects who had completed the original survey, Q1998, were contacted in February 2000 regarding their interest in completing another questionnaire (N=238 by this date). 128 owners replied positively and were sent the new questionnaire on 1st June 2000. New recruits were sought through articles in the local press and trade magazines during the spring and summer 2000. In May 2000, the website 'Headshaking: a definitive guide' (Taylor 2000) was created, and since then most subjects came via this recruitment portal. The database included all respondents in the period 1st June 2000 to 1st June 2002, who satisfied the selection criteria (see below).

In February 2001, 176 owners on the NEHS database (regardless of their participation in the Q2000) were sent a form to complete regarding their horse's experience with conventional veterinary treatments. From this time, all new recruits to the survey were also questioned about veterinary treatments as part of the larger questionnaire. (In addition they were asked to rate the ease of bridling their horse from 'very easy', 'easy', 'hard to say', 'difficult' to 'very difficult', and the effect of windy days on the headshaking; 'improves', 'worsens', 'not affected', 'don't know'). Appendix III is a copy of the final questionnaire. The sub-survey on veterinary treatments is found on the final page of the questionnaire.

3.3.2 Selection criteria

All respondents to the appeal were sent the questionnaire. The following criteria were used in selecting subjects to be included in any subsequent analysis.

3.3.2.1 Inclusion criteria

- The owner believed the horse had a current headshaking problem
- The horse was in the owner's possession at the time of completion of the questionnaire

3.3.2.2 Exclusion criteria

- Horses that were NOT reported to exhibit at least one of the following behavioural signs 'when being ridden': ***headshake*** (vertical, horizontal or rotary), ***flip the nose*** or ***twitch*** (the nose or muzzle)

Horses were not required to have been confirmed to have a headshaking problem by a veterinary surgeon. This decision was made in order to maximise the number of survey respondents and to exclude any bias in the sample towards horses that were particularly severe headshakers or more valuable, which might have occurred if this restriction had been put in place. The comparison of the reports of headshaking signs in Chapter 2 between horses with and without a headshaking problem suggested that these signs do not tend to be reported in horses that are not considered to have a headshaking problem.

3.3.3. Statistical methods

3.3.3.1 Association between increased severity of the headshaking over the summer and an increased workload over the summer

Each owner was asked to report the average number of times they rode their horse each week during the spring, summer, autumn and winter (0 = not ridden, 1 = less than once a week, 2 = 1–2 days a week, 3 = 3–4 days a week, 4 = 5–6 days a week and 5 = every day). For each season they were also asked to report how long each ride tended to be (0 = not ridden, 1 = less than 1 hour, 2 = 1–2 hours, 3 = 2–3 hours and 4 = more than 3 hours). A chi-square test of association (SAS v 8.0, SAS Institute, Inc) was used to compare the number of horses considered to be worse over the summer (i.e. seasonally affected or perennially affected with seasonal exacerbations) or not (perennially affected), with the number ridden more frequently in the summer than in the winter, or not. This test of association was similarly used for the length of ride.

3.3.3.2 Change in the month of reappearance of signs for seasonal headshakers

A comparison was made between the month of the year the horse was reported to begin headshaking for the first time and the month in which it was reported to begin in the year the questionnaire was completed. This was only made for horses that had been headshaking for more than one year and who were reportedly seasonally affected (i.e. ceased headshaking at some point over the winter). The Wilcoxon signed-rank test (for paired data) was used to test the significance of the differences in median month of first onset and onset in the year of the survey.

3.3.3.3 Change in headshaking severity and occurrence since onset

Owners were asked whether they felt their horse's headshaking had improved, worsened or stayed the same since onset both in terms of severity and occurrence. The percentage of owners giving these three response options was presented separately for the three seasonality types and for those horses for which no seasonal pattern had been offered by the owner:

- sunny seasonally affected (not affected during the winter)
- perennially affected with seasonal exacerbations (affected all year round but the headshaking is worse over the spring and summer)
- perennially affected (affected all year round with no noticeable change with the seasons)

3.3.3.4 Change in headshaking since the previous year

Owners were asked whether they felt their horse's headshaking had improved, worsened or stayed the same compared to the previous year. The percentage of owners giving these three response options was presented separately for horses that had been headshaking for between 1 and 2 years, more than 2 but less than 4 years and for more than 4 years.

3.3.3.5 Associations between certain situations and change in the headshaking

For each of the emotional and environmental situations listed in the questionnaire, a score of zero was given if the owner reported that the horse's headshaking was not affected by the situation, a score of –1 if they were reported to be worse and a score of +1 if they were reported to be better under that situation. In an attempt to summarise the general, relative reported effect of each situation, the median of the scores for each condition was presented and the Wilcoxon rank-sum test used to test if they differed significantly from zero. The test statistic, Z, is an approximation to the normal distribution of the median score. A positive value of Z indicates a tendency for more horses to be reported to improve than deteriorate and a negative value indicates a tendency for more horses to be reported to deteriorate under this condition. The size of the test statistic indicates the strength of this tendency, which is also reflected in the p-value.

3.4 Results

3.4.1 Response rate

128 original NEHS participants were sent the revised survey and 84 (66%) of these returned a completed questionnaire. 216 requests for questionnaires from horse owners in the UK were received in response to the website and press releases. Of these, 116 (54%) returned a completed questionnaire. In total, questionnaires regarding 200 headshakers from the UK were included in the survey (116 from new recruits and 84 from those that had completed the first questionnaire in 1998). No questionnaires had to be rejected in accordance with the exclusion criteria.

3.4.2 Horse characteristics

Table 3.1 summarises the sex distribution, age, breed, length of time owned by the present owner, severity of the condition and common use of the UK headshakers surveyed (N=200). Approximately two-thirds of the population were geldings. The horses were of a mature age (median 10.25 years) and were of various breeds, although thoroughbreds and their crosses were most common (32%). The majority of the horses were used primarily for pleasure, but attending local competitions was also highly prevalent (54% of horses). The typical horse had been with the present owner for between 5 and 6 years. 82% of horses (157 out of 191 respondents) had been reported to have been headshaking for at least one year and the median length of time was over 3 years.

3.4.3 Severity of the problem

The majority of respondents owned horses with a headshaking problem that they considered to be relatively severe. 71% of horses were rated to be at least 'unpleasant and difficult to control' when headshaking at their worst, see Table 3.1.

Table 3.1 The characteristics of the horses included in the 2000 UK survey, *N*=200.

Variable	Summary
Sex *N*=200	127 geldings (63.5%), 1 stallion (0.5%) 72 mares (36%)
Age (in 0.25 years) *N*=200	Mean: 11.5 years, SD: 5.5 Median 10.25 years, Range:1.75–36 years
Breed *N*=197	TBs 64 (32%), Cobs 34 (17%), Ponies 33 (17%), Warmbloods 16 (8%), Others 50 (25%)
Length of time owned by present owner (in 0.25 years) *N*=198	Mean: 6.5 years, SD: 5.00 years Median 5.75 years, Range: 0.25–36.00 years
Length of time reported to have been headshaking for (in 0.25 years) *N*=191	Mean: 4.0 years, SD: 3.25 years Median 3.50 years, Range: 0.25–16.00 years
Severity *N*=198	4 (2%) 'Barely noticeable' 54 (27%) 'Annoying, but bearable' 79 (40%) 'Unpleasant, and difficult to control' 61 (31%) 'Dangerous, and the horse is unrideable'
Uses *N*=200	150 (75%) Primarily pleasure 107 (54%) Local competition[1] 38 (19%) Affiliated competition[1] 24 (12%) Other[2] 15 (8%) Professional competition 11 (6%) Riding school 6 (3%) Not ridden (116 (58%) More than one of the above)

[1] *'Competition' included: showing, dressage, jumping, cross-country, eventing, hunter trials where specified.*
[2] *'Other' included: hunting (8), endurance/long distance (7), driving (3), racing (2), pet or companion for another horse (2) and side-saddle (2), breeding (1).*

3.4.4 Effect of the headshaking on the use of the horse

70% (140) of owners claimed that the headshaking prevented them from fully utilising their horse. The percentage of owners indicating each of the ways in which they were affected is given in Table 3.2. Owners could indicate more than one way. The most common consequences were not being able to participate in certain activities (48% of all survey respondents) or ride in certain situations (37%) rather than not being able to ride at all (23%).

Seven out of 132 respondents that had insured horses made a claim for loss of use as a result of the headshaking, a further four had claimed for treatment.

Table 3.2. The percentage of owners reporting the following effects of the headshaking condition on the full use of their horse, *N*=200. Specific comments are listed at the foot of the table with the number of comments in parentheses.

Consequence of headshaking	No. (%) affected
No effect[1]	60 (30%)
Cannot do certain activities, e.g. jump/dressage[2]	95 (48%)
Cannot ride in certain areas or situations[3]	74 (37%)
Cannot ride at all during headshaking period	46 (23%)
Must ride for shorter periods	37 (19%)
Other[4]	15 (8%)

[1] *Explanations included: because they used a nose net (19), the headshaking is mild or has improved (19), the problem can be managed, by changing riding times or areas, etc (13), headshaking signs do not occur in situations that affect the rider (9), the horse is not ridden for other reasons (4)*

[2] *Specifications included: dressage (29), jumping (13), showing (12), competition (12), schooling (6), ride at more than a walk (2), trot (4), carry children (2), hack out (2) and ride long distance (1)*

[3] *Specifications included: near trees, hedgerows or leafy lanes (13), past certain crops (8), on hot or sunny days (9), in the rain (4), when pollen count is high (2), on roads (2), in the middle of the day (3), when horse is stressed (2), when humid (2), outdoors (2), in other areas (2), on grassland (1) or on windy days (1).*

[4] *Specifications included: inability to progress with schooling (4), to maintain speed or rhythm (2), to canter (2) to get the horse to concentrate (1) to venture far from home (1) or to ride at more than a walk (1). Owners also mentioned that riding was dangerous (1), distressful for the horse (1), no longer fun (1) and that they could not sell the horse because of it (1). One owner claimed that they could not safely clip their horse.*

3.4.5 Onset of the headshaking problem

3.4.5.1 Owner awareness of the problem prior to onset

9% (18) of horses had been bred by the owner. Of the remaining 182 horses, 170 were discovered to be a headshaker following purchase (83%). Of these, 85 (50%) discovered this within a year from purchase. 29% of these horses were purchased in the spring, 24% in the summer, 29% in the autumn and 19% in the winter time.

3.4.5.2 Reported age of the horse at onset

The mean age of the horse when it first started headshaking to the best of the owner's knowledge was 7.5 years old, to the nearest quarter year ($N = 191$). However, as some horses may have been headshakers prior to purchase, so this figure may not accurately reflect the real age at which these horses began to headshake. Table 3.3 summarises the reported age of onset for the entire sample, for those with incomplete histories and for those whose history was better known, i.e. horses that were bred by the present owner, whose headshaking history was known prior to purchase and those who were brought into regular ridden work by the present owner. These sub-samples suggest that although headshaking may appear at any age, during the first year of life up until old age, the average age at onset is likely to be lower (median of around 5 years old) for horses with complete histories than for horses about whom less is known (median of 8 years old).

Table.3.3. The reported age at onset of horses in the survey; for the total sample, and separately for those with incomplete histories–those that were bred by the owner, those whose headshaking history was known prior to purchase or those that were brought into regular ridden work under the present owner (Horses fall into one of these latter categories only).

Sample	*N*	Age at onset
Total survey	191	Mean: 7.5 years SD: 4.25 years Median: 6.5 years Range: 1–27 years
Incomplete history	116	Mean: 8.5 years SD: 4.25 years Median: 8.0 years Range: 2–27 years
Bred by present owner	17	Mean: 7.75 years SD: 5.75 years Median: 4.75 years Range: 1–21 years
History known on purchase	9	Mean: 5.75 years SD: 1.75 years Median: 5.25 years Range: 2.5–8.25 years
Brought into work under present owner	49	Mean: 5.5 years SD: 3.5 years Median: 4.75 years Range: 1.25-23 years

3.4.5.3 Month of the year in which headshaking was first observed

May was the most commonly reported month in which the horses were reported to have begun headshaking for the first time to the knowledge of the owner (25% of horses, 46 out of 184 respondents). Overall, spring was the most common season for first onset of the problem–58% of horses (106 out of 184 respondents) were first noted to have started headshaking in the months of March, April or May, see Fig 3.1.

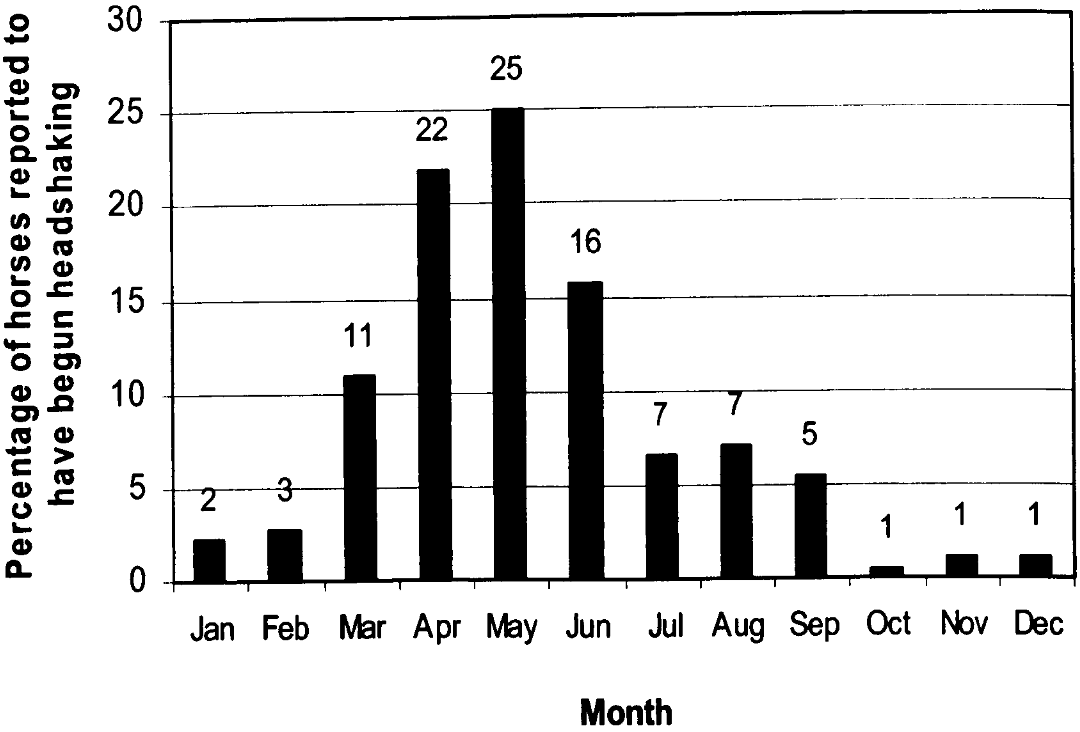

Fig. 3.1. The percentage of horses reported to have begun headshaking in each month for the first time under the present owner (*N*=184).

3.4.5.4 Events prior to the onset of the headshaking

82% of owners (149 out of 182 respondents) reported that they had moved their horse to a different area following purchase. 58% (101 out of 175 respondents) reported that they had changed the 'kind' of work the horse was used for since purchase and 67% (115 out of 172 respondents) reported that they had changed the 'level' at which the horse worked. 76% (87) of these reported that they had *increased* the horse's level of work since purchase.

56% of owners (109 out of 194 respondents) recalled an event or change in management prior to the initial onset of the headshaking whilst in their care. These are listed below (some owners indicated more than one event):

- Illness/injury[1] (34)
- Moving areas (30)
- Increase in work or recently brought back into work following injury/illness (24)
- Equine Herpes Virus vaccination[2] (18)
- Change to the local environment[3] (11)
- Change in the weather (9) (Hot, 7, sunny, 3, wet, 2)
- Backing (6)
- Stressful event (2)
- Teething (2)

[1] *Illnesses/injuries included: allergic reactions (9), facial injuries (8), viral infection (7), lameness (7), back problems (5) sunburn to the muzzle the year prior (3), colic and cough (1 report each).*

[2] *Of the 18 owners reporting onset after an EHV vaccination, 9 specifically mentioned that this was following a series of vaccinations (due either to a lapse the previous year or as part of the horse's first vaccination programme).*

[3] *Changes in local environment included: change to oil seed rape production in the next door field (8), a particularly dusty harvest (2) and an increase in buttercups in the local area (1).*

15 owners reported the context in which the horse started headshaking for the first time:

- At a show or pony camp (5)
- Riding out on a particularly hot day (4)
- During an attack by midges (2)
- When walking behind another horse (2)
- Bathing the horse (1)
- Harvesting nearby (1)

3.4.6 Seasonality of headshaking problem

3.4.6.1 Occurrence of the signs throughout the year

157 owners reported experiencing their horse headshaking for at least one year. They scored the occurrence of the headshaking each month of the (previous) year on the following scale; 0 (never), 1 (occasionally), 2 (often) and 3 (every time) the horse was ridden. From this it was possible to group the horses into 3 seasonal group types, with 5 exceptions. 98 (62%) were defined as 'sunny seasonals', that is, they were not reported to headshake in at least one of the winter months. 39 (25%) were defined as 'perennial with sunny seasonal exacerbations', as they were reported to headshake to some extent all year round but with greater frequency over the spring and summer months. 15 (10%) were defined as 'perennial' headshakers as the headshaking was reported to occur all year round with no noticeable change in occurrence over the seasons. Of the 5 horses (3%) that did not fit into any of these groupings, 2 shook very infrequently with no noticeable pattern, 2 were perennial headshakers that were reported to be worse in the winter rather than during the spring/summer and 1 shook in the autumn/winter time only. The mean score for the occurrence over the year is illustrated for the three main groups in Fig. 3.2.

The typical seasonal pattern was to begin headshaking occasionally in the spring, to increase in frequency over the summer and decrease again progressively towards the winter. Perennial headshakers with seasonal exacerbations were reported to shake more frequently over the spring and summer than the sunny-seasonally affected horses.

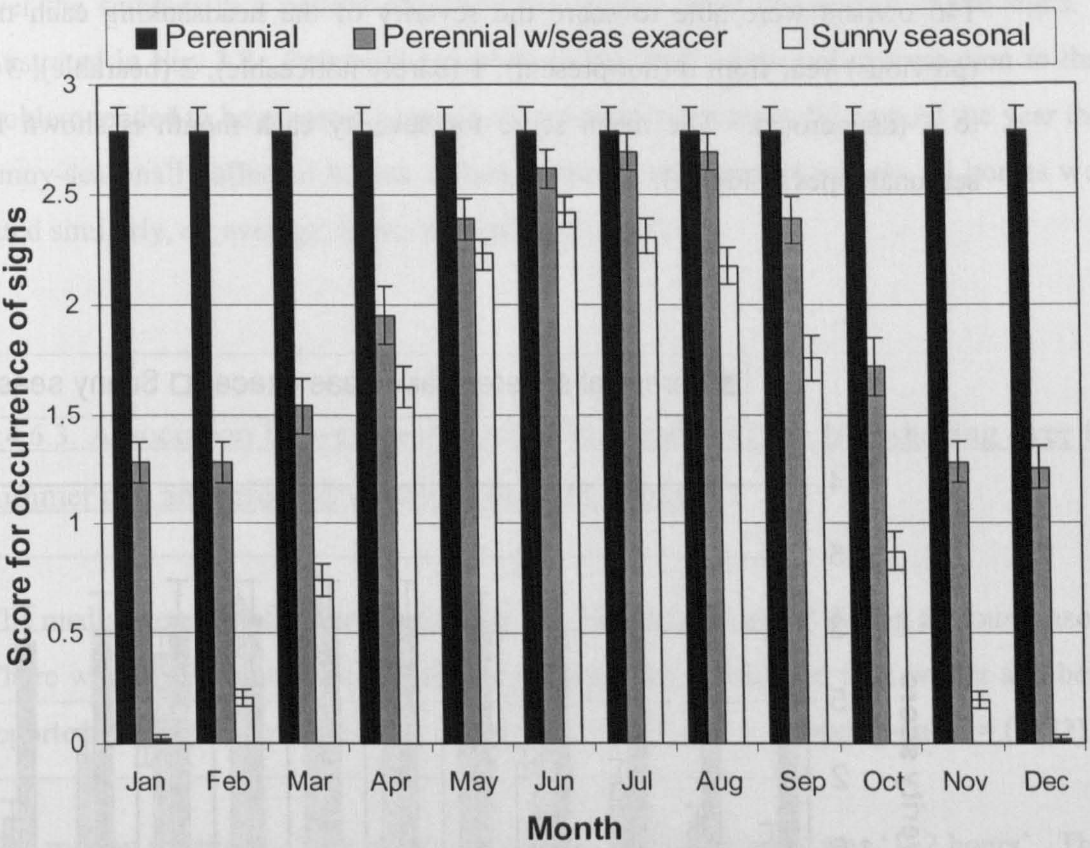

Fig. 3.2. The reported *occurrence* of headshaking (scored as 0 (never), 1 (occasionally), 2 (often) and 3 (every time)) throughout the months of the year for sunny seasonal (N=98), perennial with seasonal exacerbations (N=39) and perennial (N=15) headshakers. Mean scores for each group for each month are shown with standard error bars.

3.4.6.2 Severity of the signs throughout the year

146 owners were able to score the severity of the headshaking each month of the (previous) year from 0 (not present), 1 (barely noticeable), 2 (bearable), 3 (unpleasant) to 4 (dangerous). The mean score for severity each month is shown for the three seasonal types in Fig 3.3.

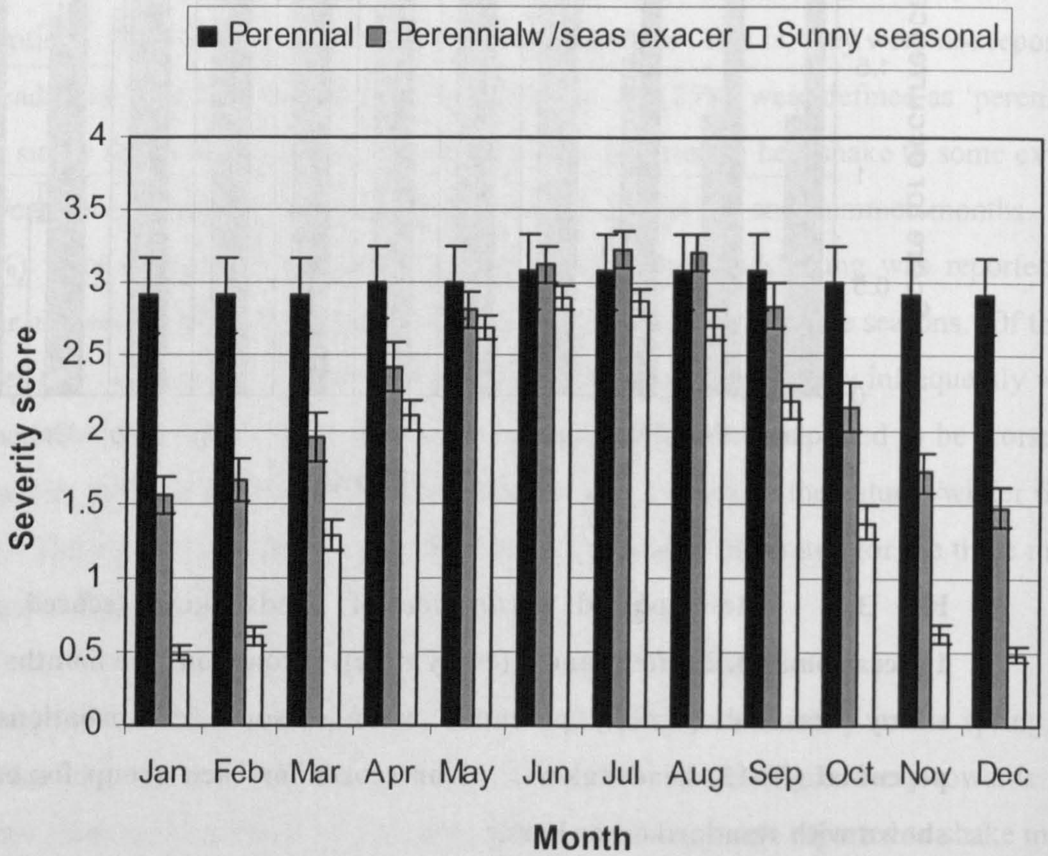

Fig. 3.3. The reported *severity* of the headshaking (scored as 0 (not present), 1 (barely noticeable), 2 (bearable), 3 (unpleasant) and 4 (dangerous)), throughout the months of the year for sunny seasonal (*N*=96), perennial with seasonal exacerbations (*N*=38) and perennial (*N*=12) headshakers. Mean values for each month are shown with standard error bars.

Perennial horses did not tend to alter in their severity throughout the year and were rated on average to be 'unpleasant to ride'. Seasonally affected horses tended to be worst over the summer in a pattern reflecting the frequency of appearance of the signs, as illustrated in Fig. 3.2. Perennial headshakers that had a seasonal exacerbation to their problem tended to be reported as more severe cases on average throughout the year than sunny-seasonally affected horses, although during the summer months all horses were rated similarly, on average, to be 'unpleasant to ride'.

3.4.6.3. Association between an increase in severity of the headshaking over the summer and an increased workload over the summer

The median reported frequency of riding was '3–4 days a week' during all four seasons. There was no association between riding more often in summer than winter and being reported to be worse over summer (chi-square = 0.41, DF = 1, exact p-value = 0.772).

The median duration of each riding session for all four seasons was '1–2 hours'. There was no association between being ridden for longer periods in summer and being reported to be worse over summer (chi-square = 2.41, DF = 1, exact p-value = 0.189).

3.4.7 Progression of the problem over time

3.4.7.1 Month of reappearance of signs

82% of horses (157 out of 191 respondents) were reported to have been headshaking for at least one year. At the time of completion of the survey, 9 of these had yet to show headshaking signs for that year and 27% (42) were reported to shake all year round. For the rest (N=106), March and April were the most commonly reported months for reappearance of signs in the year of the survey (30%, 32 horses each) and spring the most common season (79%, 84 were reported to have begun showing signs again during March, April or May). Winter was the least likely time of year for either first onset or reappearance of signs in the year of the survey.

There was a significant relationship between the month of first reported onset of the condition and the month of onset in the year of the survey, for those horses that were affected seasonally and for more than one year (N=106). The month of reported reappearance of signs in the year of the survey was one month earlier on average than the month in which the horse was first reported to show signs (Wilcoxon signed rank, $Z = -5.99$, p-value <0.001, $N = 68$ for test, median difference = –1 month).

3.4.7.2 Change in seasonality pattern

Of the 54 horses that were reported to headshake to some extent all year round, 56% (30) of their owners said that it had previously suffered only seasonally (7 did not know this history).

3.4.7.3 Change in headshaking severity since onset

Of 174 owners who responded to the question regarding any change in the severity of the headshaking problem since onset, 70 (40%) reported that there had been no change, 57 (33%) that it had improved and 47 (27%) that it had deteriorated.

That there had been no change was the most common response from owners of seasonal headshakers (49% of responses), see Table 3.4. Improvement was the most common response from owners of perennially affected horses with seasonal exacerbations (41%). Deterioration was the most commonly reported change from owners of perennial headshakers (50%). For those horses for whom a seasonal pattern could not yet be confirmed or whose owners did not complete the section on seasonal patterns, improvement, deterioration and no change were roughly equally reported, see Table 3.4.

Table 3.4. Reported changes in *severity* of the headshaking problems since onset for sunny seasonally affected, perennially affected with sunny seasonal exacerbations, perennially affected and horses for whom the seasonality pattern was not known, *N*=200.

Change in headshaking	Sunny seasonal	Perennial with seasonal	Perennial	Pattern not known
Better	27 (31%)	14 (41%)	3 (21%)	13 (33%)
No change	42 (49%)	12 (35%)	4 (29%)	12 (30%)
Worse	17 (20%)	8 (24%)	7 (50%)	15 (37%)
Don't know	12	5	1	8
N	98	39	15	48

3.4.7.4 Change in headshaking occurrence since onset

Of 169 owners who responded to the question regarding any change in the occurrence of the headshaking problem since onset, 76 (45%) reported that there had been no change, 49 (29%) that it had improved and 44 (26%) that it had deteriorated.

That there had been no change was the most common response from owners of seasonal headshakers (56% of responses), see Table 3.5. Deterioration was the most common response from owners of perennially affected horses with seasonal exacerbations (38%). Deterioration or no change was the most commonly reported change from owners of perennial headshakers (46%). Improvement in the occurrence of headshaking for perennially affected horses was rarely reported. For those horses for whom a seasonal pattern could not yet be confirmed or whose owners did not complete the section on seasonal patterns, improvement was slightly more likely to be reported than no change or deterioration, see Table 3.5.

Table 3.5. Reported changes in *occurrence* of the headshaking problems since onset for sunny seasonally affected, perennially affected with sunny seasonal exacerbations, perennially affected and horses for whom the seasonality pattern was not known, *N*=200.

Change in headshaking	Sunny seasonal	Perennial with seasonal	Perennial	Pattern not known
Better	24 (28%)	10 (29%)	1 (8%)	14 (39%)
No change	48 (56%)	11 (32%)	6 (46%)	11 (31%)
Worse	14 (16%)	13 (38%)	6 (46%)	11 (31%)
Don't know	12	5	2	12
N	98	39	15	48

3.4.7.5 Change in headshaking since the previous year

Of those owners who had experienced their horse headshaking for at least one year, 40% (56) claimed that their horse's headshaking severity had not changed compared to the previous year. 39% (54) reported that it had improved and 21% (29) that it had deteriorated ($N = 139$, 157–18 that did not know).

Table 3.6 shows the reported change in severity of the headshaking problem compared to the previous year, for those horses that had been headshaking for between 1 and 2 years, more than 2 but less than 4 years and for those that had been headshaking for more than 4 years. Horses in their second year of headshaking were more likely to be reported to have deteriorated since their first known year of the problem than horses that had been headshaking for longer. The tendency to be reported to have improved was greatest for horses that had been headshaking for between 2 and 4 years and was least for horses that had been headshaking longer than this. The tendency for there to have been no reported change was greatest for those horses that had been headshaking for at least 4 years.

Table 3.6. The reported change in the severity of the headshaking problem since the previous year as reported by owners of horses that have been headshaking for between 1 and 2 years, more than 2 year but less than 4 and for more than 4 years.

Change in severity	**Horse has been headshaking for:**		
	> 1 ≤2 years	**> 2 ≤4years**	**> 4 years**
Better	9 (41%)	26 (52%)	19 (28%)
Same	4 (18%)	15 (30%)	37 (55%)
Worse	9 (41%)	9 (18%)	11 (16%)
Don't know	8	2	8
Total	30	52	75

83% (45) of those 54 owners who reported an improvement in their horse's problem since the previous year gave an explanation for this. These are listed below; some owners gave more than one explanation:

- The use of alternative/complementary therapies, e.g. homeopathy, herbal supplements (20)
- The use of nose net (12)
- Improved weather conditions, e.g. wetter/less sunny (11)
- Changes to the horse's local environment, e.g. moving the horse or changes to the local crops (i.e. less oil seed rape production) (9)
- Improvement in the owner's knowledge and ability to cope with or avoid the attacks (9)
- Change in management, e.g. change of tack or stabling routine (9)
- The use of conventional drugs (3)

Most of the 29 owners who reported that the horse had deteriorated since the previous year gave no explanation for it, although they could describe in what way the horse had changed (more violent, more frequent attacks, etc.). Three owners attributed the deterioration to a change in the horse's local environment, two to management changes (more work) and two to the failure of alternative therapies compared with the previous year.

3.4.8 Physiological and environmental situations affecting the headshaking

Table 3.7 summarises the number and percentage of horses reported to be positively, negatively and not affected by various physiological and environmental situations.

The majority of horses ($p<0.001$ in all situations) were reported to be adversely affected by:

- *riding through a cloud of midges* (87% of horses, $Z = -12.45$, N for test = 159)
- *riding on warm days* (73% of horses, $Z = -11.00$, N for test = 129)
- riding on *bright, sunny days* (69% of horses, $Z = -10.52$, N for test = 130)
- *riding in wooded areas* (71% of horses, $Z = -9.41$, N for test = 122)
- *riding through arable areas*[1] (58% of horses, $Z = -8.87$, N for test = 94)
- as *exercise progresses* (67% of horses, $Z = -8.28$, N for test = 150)

[1] *oil seed rape/linseed crops were particularly mentioned (69 out of 103 comments)*

The following tended to be reported to have a positive effect on the headshaking ($p<0.001$ in all situations)

- *riding indoors* (66% of horses, $Z = 8.19$, N for test = 86)
- *riding on overcast days* (46% of horses, $Z = 7.38$, N for test = 90)
- *in open spaces* (43% of horses, $Z = 5.16$, N for test = 60)
- *at night* (43% of horses, $Z = 4.62$, N for test = 51)
- *in the rain* (43% of horses, $Z = 3.70$, N for test = 111)

Loud or sharp sounds, *riding in traffic* and *on windy days* were not reported to have a significant effect on the headshaking ($p>0.05$).

The majority of horses were not reported to alter in their severity when lunged as opposed being ridden (45%, 18 out of 40 respondents). However, of the remainder, more were reported to improve (38%, 15) than deteriorate (16%, 6 horses) when lunged.

Table 3.7. The number and percentage of owners (out of those who knew) who reported their horse's headshaking to be affected by the following physiological and environmental situations. Shaded cells indicate situations in which 50% or more of the horses were reported to behave similarly.

Situation	*N*	Don't know	Improves +1	No effect 0	Worsens -1
As *exercise* progresses	200	10	22 12%	40 21%	128 67%
Feeling *excited*	200	23	21 12%	63 36%	93 53%
Feeling *nervous*	200	43	13 8%	67 43%	77 49%
Encouraged to *concentrate*	200	19	72 40%	57 31%	52 29%
A cloud of *midges or flies*	200	18	1 1%	23 13%	158 87%
On *warm* days	189	16	2 1%	44 25%	127 73%
Through *wooded* areas	200	40	9 6%	38 24%	113 71%
On *bright, sunny* days	200	19	5 3%	51 28%	125 69%
Through *arable* areas[1]	200	45	4 3%	61 39%	90 58%
On *windy* days	50	12	5 13%	23 61%	10 26%
In the *rain*	189	14	75 43%	64 37%	36 21%
In *open spaces*, e.g. moorland or beaches	200	83	50 43%	57 49%	10 9%
At *night* time	200	102	42 43%	47 48%	9 9%
On *overcast* days	200	25	80 46%	85 49%	10 6%
In *traffic*	200	39	7 4%	145 90%	9 6%
Indoors	200	78	81 66%	36 30%	5 4%
Near *loud or sharp sounds*	200	37	3 2%	154 94%	6 4%

[1] *crops in particular included: Oil seed rape (65), other flowering crops or grasses (12), cow parsley (5), linseed (4), harvest time (4), hedgerows (3), stubble fields (3), corn fields (2), muck spreading, crop spraying, cut grass, grass fields, blossom (1 each).*

There was no clear tendency for horses to be reported to either, improve, deteriorate or remain unchanged when they were *encouraged to concentrate*. Some factors such as the effect of riding the horse *indoors*, in *open spaces* such as on beaches, or *at night* had not been tried by many owners.

Owners were also asked to indicate any other environmental factors that affected their horse. Distracting the horse and riding on cool days were most commonly reported to improve signs (11 and 7 reports respectively). Riding past specific species of plant such as cow parsley and doing schooling or dressage work were most commonly reported to make the signs worse (11 and 10 reports respectively). All the factors mentioned are summarised below, owners could list more than one:

For the better

- Distracting the horse or doing something it enjoys (11)
- Cool days (7)
- Jumping (6)
- Wet days (4)
- Relaxing the horse (4)
- Schooling (3)
- Trotting hard (2)
- Loose rein contact (2)
- Riding early morning (2)
- Riding on roads (2)
- Drizzle, ignoring it, dry days, change of schooling surface, still days, give food, rub the nose, ride in company, driving, ride in evening, going slower (all 1 comment each)

For the worse

- Certain plants, esp. cow parsley (11)
- Schooling/dressage work (10)
- Stress (9)
- Humid days (8)
- Having a tight rein contact (8)
- Days with a high pollen count (5)
- Dusty schooling areas (5)
- Riding at faster paces (4)
- When the horse is hot and sweaty (4)
- When separated from other horses (3)
- Snowflakes (3)
- Dappled light (3)
- Just walking (2)
- Drizzle (2)
- Dry spells, other horses moulting, overreacting to it, rushes and reeds, fly spray, riding behind another horse, grass being cut, if not turned out (all 1 comment each)

3.4.9 Reported success of conventional and non-conventional treatments for headshaking

3.4.9.1 Reponses from the general survey

The nose net was the most popular and successful treatment reported by the owners in the questionnaire. It had been tried by 88% of owners and was reported to provide some degree of relief in 73% of their horses, see Table 3.8. However, complete success with a nose net was only reported in 13%. Face nets had been tried by fewer owners (32%) but were also relatively successful, reportedly helping 56% of their horses. 'Veterinary treatment' was less successful, reportedly helping just over 40% of horses that had used it. Its reported success rate was similar to that also reported for herbal supplements and homeopathy (just over 40% of those that had tried it). The use of a bitless bridle was relatively rare, just over 20% of the survey respondents reported trying one for headshaking, and it was not reported to be very effective (reportedly helping about 20% of these).

Owners were invited to list other treatments that they had tried and these are summarised in Table 3.9. (Some owners listed more than one treatment hence the difference in total numbers in Table 3.8 to Table 3.9.). Smearing creams around the nostrils had been tried by 11 owners and was reported to help in seven cases. Similarly, putting sun block on the nose was reported to help all five horses whose owners reported trying it. A fly fringe placed over the nose (instead of on the brow, as is normal) was reportedly helpful in eight out of 10 instances.

Table 3.8. The reported success (none, partial, substantial and complete) of conventional, veterinary treatments and other treatments tried for the headshaking condition, listed in descending order of the percentage of horses that had tried it. The percentage success is out of those that tried it; DK indicates the number of owners that did not report the treatment's level of success.

Treatment	*N*	Tried	Success:				
			None	Partial	Substantial	Complete	DK
Nose net	199	176 88%	48 27%	48 27%	57 32%	23 13%	0
Veterinary advice	199	144 72%	110 79%	15 11%	12 9%	3 2%	4
Herbal supplement	198	117 59%	65 57%	35 30%	13 11%	2 2%	2
Back specialist	198	97 49%	77 79%	14 14%	2 2%	1 1%	3
Other[1]	193	86 45%	32 38%	29 35%	21 25%	2 2%	2
Veterinary treatment	198	84 42%	47 57%	24 29%	11 13%	1 1%	1
Homeopathy	198	79 40%	43 54%	22 28%	11 14%	3 4%	0
Face net	199	64 32%	28 44%	22 34%	11 17%	3 5%	0
Bitless bridle	189	41 21%	33 80%	6 15%	2 5%	0 0%	0

[1] *see Table 3.9*

Table 3.9. Other treatments tried by owners for the headshaking problem and their reported success (none, partial and substantial/complete). Treatments are listed in descending order of most commonly reported treatment.

Other treatment	Total	No success	Partial success	Substantial or complete success
Creams around the nostrils	11	4	6	1
Change of tack	11	6	2	3
Fly fringe over the nose	10	2	1	7
Acupuncture	10	7	2	1
Aromatherapy oils on the face	9	4	5	0
Other supplements	9	6	3	0
Alternative healing practices	8	1	6	1
Fly repellent	6	0	5	1
Sun block on nose	5	0	5	0
Other drugs (without vet)	5	3	1	1
Stabling in day	4	0	2	2
Ear covers	2	0	0	2
Neutralisation injections	2	0	1	1
Sugar free, unprocessed diet	2	0	0	2
TENS [1]	1	0	1	0
Other management changes [2]	4	0	0	4
TOTAL	99	33	40	26

[1] *Transcutaneous electrical nerve stimulation*

[2] *soaking hay, riding on beach, relaxation techniques, working less*

3.4.9.2 Responses from the supplementary survey regarding veterinary interventions

The supplementary survey regarding the success of veterinary interventions was sent out separately to all survey participants prior to February 2001, but after this time was included as part of the complete survey (Q2000). 99 of 176 (56%) that were sent the survey separately returned completed forms. Of these, 45 (45%) reported that their horse had been treated by a veterinary surgeon at some stage for the headshaking condition. Of 100 Q2000 questionnaires sent out between February 2001 and June 2002, 42 (42%) were returned completed. Of these, 23 (55%) owners had completed the section on veterinary interventions in addition to the rest of the survey.

In total, 68 out of 141 horses (48%) were reported to have been treated by a veterinary surgeon for headshaking in this section of the survey. The type of intervention and its reported success by the owner is listed in Table 3.10. A wide range of interventions was reported to have been applied. The overall reported success of 152 interventions was 37% (56 reported at least slight improvement). The most commonly reported interventions were steroids (42 reports of steroidal tablets, nebulisers and injections). These were reported to have given at least slight improvement in about one third of attempts (15 cases), though there were comments regarding a lack of lasting improvement or difficulty in administration for some forms. Homeopathy was attempted in 18 horses, Cyproheptadine in 16 and a temporary, nerve blocking procedure in 14. Homeopathy and the temporary nerve blocking procedure were reported to produce at least slight improvement in one third of horses. However, the temporary nerve blocks were for diagnostic purposes only and not all horses were reported to tolerate the procedure. Cyproheptadine was reported to be helpful in over 50% of cases. Several owners reported that they preferred to use it occasionally (e.g. to relieve symptoms before an important event or if the horse was particularly suffering). Wolf tooth removal was reported to help a quarter of the horses, although an additional eight owners mentioned in this section that their horse had a wolf tooth removed prior to the onset of the problem.

Table 3.10. The reported success of veterinary interventions for headshaking (Number of horses=68, total number of treatment reports=152).

Treatment type (No. reports)	Worse	None	Slightly better	Better	Much better	Comments
Tablets (59)						
Cyproheptadine (13)	0	6	1	3	3	Used sporadically
Homeopathic via vet (18)	0	12		5	1	
Carbemazepine (3)	0	2		1		
Cyproheptadine and Carbemazepine (3)	0	3				
Steroids (13)	1	9	3			
Other (9)		5		1	3	Collapsing: Hydroxyzine (2), Temporary: Phenylbutazone (1)
Nasal sprays or nebulisers (25)						
Beclomethasone (steroidal nasal spray) (13)	1	7	2	2	1	Difficult to administer (5)
Nebulised, other (8)	0	5	1	1	1	Temporary (3)
Other (4)	0	4				
Injections (24)						
Steroid (incl.Depomedrone) (16)	1	8	4	3		Temporary (7)
Desensitisation solutions (Miller technique) (4)	0	3		1		
Other (4)	0	3		1		Temporary (1)
Temporary nerve block (11) (+3 horses refused procedure)	1	4	1	3	2	Investigative only
Wolf tooth removal (8)		6		2		
Creams (8)						
Vet cream (lidocaine, etc) (5)		3		2		
Alternative creams (3)		1		1	1	Allergic reaction (1)
Ear drops - for ear mites (7)		6			1	Temporary (1)
Supplements (6)		4		2		
Operation on facial nerves (2)		1			1	
Other dental work (2)				2		
TOTAL	4	92	12	30	14	

3.5 Discussion

3.5.1 The effect of the problem on the owner

The most common complaint from owners regarding the effect the headshaking problem had on them was that they could not do certain activities (48%), although a substantial proportion were prevented from riding at all during the headshaking season (23%). Not being able to do dressage was a particular concern. The lack of concentration, rhythm or actual headshaking movements in the horse meant that they would probably not be successful in competitions. At the time of the survey, many complained that they were not allowed to wear a nose net in competitions in order to prevent this from happening. Use for amateur dressage *per se* was not found to be over-represented in the headshaking population (see Chapter 2), so perhaps the association made by Cook (1992) between headshaking and this type of work has arisen more from the fact that headshakers cannot do dressage rather than any role of dressage in the cause of headshaking. These results suggest that, although horses can be severely affected; for many, the primary concern is that the behaviour is not compatible with the owner's preferred form of equitation.

3.5.2 Onset of the problem

The vast majority of owners reported that they discovered their horse had a headshaking problem following its purchase (83%). Nearly 50% of these discovered this within one year of ownership, leaving open the possibility that the horse was actually a headshaker prior to purchase, particularly as around two-thirds of horses were reported to headshake seasonally. Lane and Mair (1987) found that many of the headshakers in their study were purchased over the winter when the headshaking signs may have been less apparent and suggested that this time of year might result in more headshakers changing hands. For horses in the survey described here winter was actually the least commonly reported time for purchase. However, the difference in reported age of onset between horses with full histories and those with incomplete histories suggests that this may be going on. The reports regarding horses with more complete histories suggested that five years was a particularly common age for onset of the problem. Whether this age is significant because the pathology causing the headshaking becomes significant at this age or because at this age the horse is ridden regularly and the headshaking becomes apparent to the owner is not known. Other authors have reported a mean age of onset higher than this (6.5 years–Lane and Mair (1987), 9 years–Madigan and Bell (2001), 7.5 years–Mills *et al.* (2002a)), but the evidence from the survey here suggests that these ages might have been inflated by horses with incomplete histories.

Commonly reported occurrences prior to onset included illness or injury (particularly allergic reaction, viral infections or facial trauma), relocation of the horse, an increase in workload, Equine Herpes Virus (EHV-1) vaccination and changes to the horse's local environment such as a change to crop production or weather. Many owners reported that these changes occurred following purchase and since 50% of horses began headshaking within a year from purchase, these changes may be worthy of further investigation. Moving the horse has been identified previously as a potential trigger of headshaking (Lane and Mair 1987) as has contact with EHV-1 (not necessarily from vaccination) (Madigan 1996). However, a risk factor analysis with a large sample of control horses would be needed to establish whether these are significant factors. Sunburn was reported in some horses prior to and following onset of headshaking, but whether owners are mistaking the abrasions caused by excessive nose rubbing as sunburn or whether this is a significant risk factor remains to be established.

Spring was the most common time of year reported for first onset of the headshaking problem and for subsequent reappearance of signs each year. The proportion reporting this is higher than that expected by chance. This pattern has also been reported by other authors (Madigan and Bell 2001, Newton *et al.* 2000, Mills *et al.* 2002a, Lane and Mair 1987). Lane and Mair (1987) reported that the most common months for onset were March and June, but in the year of this survey the most common months were slightly earlier, April and May. As has been suggested by Knottenbelt (1998), a small proportion of horses were reported to start for the first time in late summer/early autumn, although this time of year was very rare for reappearance of signs in subsequent years.

3.5.3 The reported seasonality of the problem

Rhinitis has been suggested as a cause of headshaking in horses (Lane and Mair 1987, Cook 1980a). In the human form of the condition sufferers have been classified into those that are affected perennially, perennially with seasonal exacerbations and seasonally (Sibbald and Rink 1991). The reported pattern for the occurrence of headshaking in 97% of the horses in this survey fitted into one of these three descriptions. Sibbald and Rink (1991) found in their study that 11% of human sufferers were only seasonally affected, 34% were affected perennially with seasonal exacerbations and 55% were affected perennially. These proportions differ from those in this study where more horses were reported to be only seasonally affected (62%) and fewer to be perennially affected (10%). Whether these patterns of seasonality reflect the progression in severity of a single condition or completely different diseases is uncertain, although progression from seasonal to perennial affliction has been reported (see below). This question also remains unanswered in relation to human rhinitis (Sibbald and Rink 1991).

The vast majority (86%) of horses were reported to show an increase in severity and occurrence in their headshaking problem over the spring and summer months. However, this pattern was not mirrored by an increase in number or the duration of rides per week over this time compared to the winter. This suggests that the reported seasonality of the syndrome is not a direct result of the amount of work imposed on the horse, contrary to the suggestion by Cook (1992). However, owners may have since reduced their riding over the summer months in response to the problem, and so the role of increased exercise in the initial onset of the condition remains to be determined.

3.5.4 Changes in severity and occurrence over time

It has been suggested that headshakers tend to deteriorate progressively over time (Knottenbelt 1998). 56% of the horses in this survey that were reported to suffer all year round apparently used to do so only seasonally. And, there was a progression towards deterioration in both occurrence and severity between seasonally affected and perennially affected horses. This suggests that there is a tendency for deterioration over time. However, overall, improvement or no change was slightly more likely to be reported than deterioration since onset or compared to the previous year.

It has also been suggested that horses tend to initially deteriorate during their second year of headshaking and then stabilise (Madigan, pers. comm.). There was evidence from this survey that deterioration is more likely to occur between the first and second years of the problem as opposed to later years. However, how much of this is influenced by treatment, changes in owner's attitude and the disease's natural progression is not known. It is possible, for example, that increased owner vigilance following the first year of the headshaking led to finding that signs were being reported to reappear on average a month earlier than when they were initially noticed.

3.5.5 The reported effect of emotional and environmental situations on the headshaking

There were several common associations made between the severity of the headshaking and certain situations. The majority of owners reported that their horse was worse when riding through a *cloud of midges* (87% of respondents), riding on *warm days* (73%), riding on *bright, sunny days* (69%), riding in *wooded areas* (71%) and as *exercise progresses* (67%). These associations have been variously reported by other authors (Lane and Mair 1987, Madigan *et al.* 1995, Newton *et al.* 2000, Madigan and Bell 2001). However, to date, no one has recorded the proportion of owners that have made these associations in an appropriate sample of horses. The questions did not attempt to grade the extent to which each of the situations was thought to affect the headshaking, so it cannot be determined which situations were believed to produce the most negative or positive effect.

The situations that the owners associated with deterioration or improvement in the severity of their horse's headshaking can implicate a variety of trigger factors. Deterioration of the headshaking in a number of the situations listed in the survey may suggest that the headshaking is directly caused by superficial irritation of the face (for example, when riding through a cloud of midges, in wooded areas and in the rain).

Deterioration under virtually the same situations, perhaps with the exception of rain, may equally suggest that the headshaking is directly caused by irritation within the horse's nasal passages. However, these situations may simply be exacerbating, or lowering the threshold for response of a condition that is triggered by some other unknown factor.

There are a number of problems with the interpretation of these situations into definite trigger factors. Firstly, each environmental circumstance may represent a number of potential trigger factors making it impossible to determine the prime trigger. For example, *bright, sunny days* may contain the potential triggers of heat, photic levels, dust particles and length of ride (although no evidence was found to suggest that length of riding varied with seasonality of the condition, see Section 3.5.3). An association between riding on bright, sunny days and headshaking does not necessarily therefore imply implicitly that the headshaking is due to a hypersensitivity to light levels. Secondly, the association is only that, a connection between an event and the occurrence or severity of the headshaking that the owner has made. The owner may be mistaken. For example, Knottenbelt (1998) suggests that owners are mistakenly making the association with flying insects because the behaviour itself looks like the horse is being attacked by insects. Since associations have been made between environmental conditions and headshaking for many years (at least since Lane and Mair 1987) it is plausible that owners are perpetuating a myth in their eagerness to find connections in order to explain their horse's behaviour. Thirdly, the horse may truly be affected by several different trigger factors so a differentiation between deterioration and one specific event is not possible. Finally, it is possible that a third, unknown factor is involved between with the two associated events. Nonetheless, the consistent reporting of a deleterious effect of certain conditions and times of the year does seem to suggest that there is some external component to the problem.

Riding *indoors* was reported to be helpful more often than riding *at night*, which might suggest that there is one or more factor absent indoors other than natural light. Although most horses tended to be no different in their severity of headshaking signs when being lunged compared to being ridden, there was a tendency to improve rather than deteriorate in this situation. This might relate to lack of tack and rider, but this improvement may also be a result of exercise in a different area to that in which the horse is normally exercised. Since various environments, such as *wooded areas,* were associated with deterioration in the headshaking, horses may be perceived as being better when lunged simply because this does not tend to occur in these areas. A similar explanation may also apply to the improvement when ridden indoors. Overall, the results suggest, as is often reported by owners (pers. obs.), that the presence of the rider on the back has little effect. Madigan (cited by McDonnell 1998) suggested that headshaking might also be triggered by loud or sharp sounds via a mechanism similar to that proposed for photic headshaking. However, very few headshakers were reported to be affected by *loud or sharp sounds* in the questionnaire, suggesting that the prevalence of this form of the condition in these horses is low.

The lack of a simple association with *rain* may have been due in part to some owners feeling the horse was better in heavy rain and others feeling that the horse was worse in light rain. A deleterious effect of light rain might suggest a hypersensitive muzzle and an improvement in heavy rain might indicate the involvement of airborne particles since these tend to be reduced in heavy rainfall. In general, deterioration in cold weather, wind and rain was not commonly reported. This is in contrast with the reports from a sample of headshakers by Newton *et al.* (2000). Given that light, tactile stimulation and cold weather are commonly reported to trigger the symptoms of trigeminal neuralgia in human sufferers (Rasmussen 1991), the lack of an association might suggest that this is less significant cause of the headshaking in the horses in this sample.

3.5.6 Reported success of conventional and non-conventional treatments

The results regarding conventional and non-conventional treatments were similar to those found in Mills *et al.* (2002b), which is not surprising given the similar demographics and partly repeated sample. (Horses also included in the survey by Mills *et al.* (2002b) were not excluded from the new survey as they may have experienced additional treatments in the two years since the first questionnaire). Both their study and the new survey found that less than half the owners reported the use of veterinary interventions. Of these, the success of such interventions was generally reported to be poor (around 40% reported some improvement). This finding might be expected from a survey sample such as this, as satisfied owners with cured horses may be less likely to seek out additional information regarding the condition and/or reply to requests for help with a survey. However, low success with veterinary treatment has also been reported in a field study (Mair *et al.* 1992) and the personal experience of a veterinary surgeon (Cook 1992).

The use of alternative treatments was more commonly reported than veterinary treatment and may reflect the owner's frustration with the lack of success or availability of this type of treatment for the condition, as suggested in Chapter 2. The majority of owners (72%) reported that they had consulted the vet regarding the horse's headshaking problem but the horses did not improve as a consequence of any resulting advice (79% of these). Some owners reported that they had in fact not been offered any treatment (13 comments). The context in which the owner presented the problem to the veterinary surgeon was not apparent from this survey; nonetheless it does highlight an area for concern.

Whether this lack of help from the veterinary surgeon is a result of poor knowledge of treatment of this condition in general or represents a lack of awareness of management aids such as the nose net amongst the veterinary community is subject to speculation. Certainly, the wide range of veterinary treatments reported to have been tried in this survey seems to reflect the general lack of knowledge about the aetiology of the condition. However, given that some veterinary treatments, such as cyproheptadine, were reported by owners in this survey to reduce signs in approximately 50% of horses that have tried it, the lack of uptake of veterinary treatments is a further cause for concern.

The results also highlight that owners themselves have tried various alternative treatments for the problem. Facial coverings, especially of the nose, seemed to be the most effective, with nose nets apparently helping in over 70% of horses. However, seeking the assistance of a back specialist yielded little success, possibly because many horses were found to have nothing wrong with their backs (32 comments). The use of a bitless bridle had not been reported to have been tried by the majority of owners. Given the apparently high prevalence of the use of alternative therapies and management aids for the headshaking condition and their varying reported success, it is wise for future work to focus on the scientific evaluation of the effectiveness of some of these. To date, only one such study has been reported (Mills and Taylor 2003). Not only will this allow the extent of any improvement reported during treatment to be evaluated in a more rigorous manner, but it may also aid our understanding of the condition by looking at the characteristics of those horses that do improve under the management aid in question.

Chapter 4

Part II

A survey of 200 UK headshakers:

2. Comparisons with other surveys

4.1 Introduction

To date, three surveys have been published in the veterinary press regarding horses with a headshaking problem; Lane and Mair (1987), Madigan and Bell (2001) and Mills *et al.* (2002a). An additional survey of 200 horses was described in Chapter 3 (Q2000). These surveys have differed in their selection of subjects, method of data collection and the location of the horses, but a summary of the details of the horses included in these four surveys has not been produced. If there are major differences in the presentation of the condition between these types of study then one cannot be confident that they relate to the same condition. For example, the horses included in Lane and Mair (1987) and (part of) Madigan and Bell (2001) were referral subjects and their details would have been recorded by the attending veterinary surgeon. In contrast, the horses included in Mills *et al.* (2002a) and the adapted survey Q2000 (described in Chapter 3) were those whose owners had volunteered to complete a written questionnaire because they believed their horse had a headshaking problem. Whilst in both situations the owner is the one initially presenting the problem, there is a possibility that those included in the referral studies fitted a particular description that might not be consistent with the one recognised by owners as 'headshaking'. Madigan and Bell (2001) included horses from mostly North America whereas Mills *et al.* (2002a) and Lane and Mair (1987) involved horses from the United Kingdom only. It has been reported that horses in the USA might be headshaking in response to light (Madigan *et al.* 1995). This has yet to be demonstrated in UK horses (Knottenbelt 1998) and differences in their reported characteristics might help explain this discrepancy. Finally, there is also the opportunity to compare two, similarly selected surveys, (Mills *et al.* 2002a) and Q2000 (Chapter 3). Evidence of similarities between these two surveys would suggest a consistency to the 'headshaking condition' as presented by the owner and increase our confidence in the reliability of their reports.

A higher proportion of males to females has been consistently reported in the headshaking surveys described above. In the majority of cases 'males' were castrated adults, known as geldings. Lane and Mair (1987) reported that 69% of the horses in their survey were geldings, Mills *et al.* (2002a) reported 63% and Madigan and Bell (2001) reported 72%. A sex ratio of 2 males to every female has also been reported in other, smaller studies (Newton *et al.* 2000, Madigan *et al.* 1995), though not all (Mair *et al.* 1992, Mair 1999). Some authors have suggested that this sex bias simply reflects the normal distribution in the UK horse population (Newton *et al.* 2000). Others have suggested that it may indicate that there is a genetic component to the syndrome (Cook 1980b, Madigan and Bell 2001, Mills *et al.* 2002a). Two surveys of the general horse population by the Produce Studies Group reported a slight bias towards males. Their survey of approximately 400 horses in 1996 reported a sex ratio of 1.4 males to 1 female (Produce Studies Group 1996). A similar survey three years later reported a slightly lower bias of 1.2 males:1 female (Produce Studies Group 1999). However, a survey by Mellor *et al.* (1999) of 1264 horses in the North of the United Kingdom reported the sex ratio to be 1:1.

Clearly, without a direct comparison of the ratio of males to females between a sample of headshakers and a sample of non-affected horses surveyed at the same time, it is not possible to say whether the male bias is a genuine reflection of the sex distribution of the general purpose horse population or a significant factor. It was not possible to do this with the case-control study presented in Chapter 2 since horses were matched by sex, amongst other characteristics. Madigan and Bell (2001) recently conducted a small-scale case-control comparison with 39 horses. They reported that the male bias was not likely to be a reflection of the normal population and that males were twice as likely as females to be headshakers. However, since this was an extremely small sample and based on horses in the USA, the need for a larger comparison of the sex ratio in a sample of headshaker and non-affected horses in the UK is still required.

4.2 Aims

1. To test the null hypothesis that there are no differences in reported characteristics between horses in
    a. A referral study from the UK (Lane and Mair 1987) and a referral study from the USA (Madigan and Bell 2001)
    b. A referral study from the UK (Lane and Mair 1987) and a self-selected survey from the UK (Mills *et al.* 2002a)
    c. A referral study from the USA (Madigan and Bell 2001) and a self-selected survey from the UK (Mills *et al.* 2002a)
    d. Two self-selected surveys from the UK (Mills *et al.* 2002a) and Q2000 (described in Chapter 3)
2. To estimate the odds ratio of male: headshaker, using horses sampled in the Q2000 survey

4.3 Method

4.3.1 Comparisons between surveys

A comparison of a range of horse characteristics was made between the surveys of:

a. Lane and Mair (1987) and Madigan and Bell (2001)
b. Lane and Mair (1987) and Mills *et al.* (2002a)
c. Mills *et al.* (2002a) and Madigan and Bell (2001)
d. Mills *et al.* (2002a) and the survey described in Chapter 3 (Q2000)
   Only new participants to the Q2000 were included, i.e. those horses that did not feature in Mills *et al.* (2002a).

Each study was classified as a 'referral' (horse was admitted to the veterinarian for investigation of the headshaking) or 'Q' (a postal questionnaire that was completed by the horse owner) and the location of the horses participating in the study was recorded. The number of horses in each study was recorded and *N* given for each characteristic if it was different to the survey total, usually because of non-report or 'don't know' options in the questionnaires. The following characteristics were chosen because they were reported in the majority of the surveys:

- Percentage that were geldings
- Percentage that were thoroughbred (including crosses)
- Percentage used primarily for pleasure
- Percentage that were sunny seasonally affected (ceased headshaking at some point over the winter)
- Mean age at onset
- Mean length of time the horse had been headshaking for
- Percentage reported with vertical headshaking
- Percentage reported with acting like bee flew up the nose
- Percentage reported with rubbing the muzzle on objects
- Percentage reported with snorting
- Percentage reported with a deterioration in headshaking on bright sunny days
- Percentage reported with an improvement in headshaking during night time

In addition, the sex ratio for each survey sample, males to females (M:F), was calculated by dividing the number of males (geldings and stallions) by the number of females.

The number of horses with each characteristic (with the exception of age at onset and length of time headshaking) was compared between each survey pairing using the chi-square test of association (SAS v 8.0, SAS Institute, Inc). The number of chi-square tests that were carried out may have increased the risk of type I errors (detecting a significant difference by chance). Therefore the Bonferroni correction was applied to all test results (i.e. the p-value was multiplied by the number of tests, 36). This raised the level of significance (alpha) to 0.001, effectively meaning that only p-values of less than 0.001 were treated as significant evidence of a difference between the two studies in question.

4.3.2 Estimation of the male: headshaker odds ratio

All participants in Q2000 (described in Chapter 3) were asked to write down the number and sex of all the horses in the same yard or field as their horse, towards the end of the questionnaire (see Appendix III). The proportion of male and female headshakers participating in the survey (headshaker sample) was compared to the proportion of male and female horses reported to be resident on the same yard as each headshaker (control sample). Yards that held more than one headshaker on the database were counted only once. The odds ratio of male: headshaker was calculated by comparing the ratio of males to females in the headshaker sample with the ratio of males to females reported in the control sample (SAS v 8.0, SAS Institute, Inc). The chi-square test of association was applied to the number of horses of each sex (male or female) and survey sample (control or headshaker) to establish whether there was a bias for one sex in one of the survey samples.

4.4 Results

4.4.1 Comparison of horse details between surveys

4.4.1.1 General patterns

Table.4.1 summarises the basic details and headshaking characteristics reported in the horses included in each of the four surveys. All reported a greater percentage of geldings than mares in their sample (62–72%). The ratio of male to female horses varied from 1.6:1 in the Q2000 UK survey to 2.7:1 in the largely US survey of Madigan and Bell (2001). All surveys reported a significant proportion of horses to be affected seasonally (53–66%). The age of the horse at the reported onset of the headshaking problem was also similar in the studies, an average of around 7 years of age, although Madigan and Bell (2001) reported it to be slightly older (9 years of age). The length of time the horse had been headshaking before referral or completion of the survey was also similar in the studies (a mean of around 3 years), with the exception of the exclusively referral sample of Lane and Mair (1987), which reported that the horses had been headshaking for less than one year on average.

Vertical headshaking was reported in most, but not all, of the horses in the surveys (79–93%). *Rubbing the muzzle on objects*, *snorting* and acting like '*a bee flew up the nose*' were also very commonly reported behaviours. An association between appearance of the signs of the syndrome and *bright, sunny days* was consistently reported (35–64%).

Table 4.1. The percentage of horses reported with a range of general and headshaking characteristics in the surveys by Lane and Mair (1987), Madigan and Bell (2001), Mills *et al.* (2002a) and Q2000 (new recruits only). Mean, (median), [range] and *N*, if different from the survey total, values are given where applicable.

Study	**Madigan & Bell (2001)**	**Lane & Mair (1987)**	**Mills *et al.* (2002a)**	**Q2000 (Chapter 3)**
Type of study	Q Survey & referral	Referral	Q survey	Q survey
Location of horses	86% USA	100% UK	100% UK	100% UK
No. of horses	109	100	254	116
Geldings	72%	69%	63%	62%
Sex ratio M:F	2.7	2.6	1.7	1.6
Thoroughbreds (incl. crosses)	41%	16%	37%	28%
Primarily pleasure use	43%	72%	91%	72%
Headshaking characteristics:				
Sunny seasonal	53%	66% (*N*=29)	63%	65% (*N*=93)
Age at onset, years	9.0 [1-30]	6.5	7.5 (6.0) [0-23.5]	7.8 (7.0) [1-27]
Headshaking for, years	N/a [?-8]	0.75	3.6 (3.0) [0.25-28]	2.7 (2.0) [0.25-15]
Vertical headshaking	89%	86%	92%	93%
'Bee up nose'	88%	n/a	72%	74% (*N*=50)
Rubbing muzzle on objects	75%	58%	79%	82%
Snorting	64%	46%	73%	86%
Association with *bright, sunny* days	52%	35%	64%	64% (*N*=102)
Reduced signs at *night*	52%	n/a	75% (N=203)	37% (*N*=57)

4.4.1.2 Referral study from the UK (Lane and Mair 1987) compared to a referral study from the USA (Madigan and Bell 2001)

There was a significant difference between these two studies in the proportion of horses that were classified as thoroughbreds, with Madigan and Bell (2001) reporting a higher proportion in their study (chi-square = 14.74, $p<0.001$), see Table 4.1. There was also a significant difference between the studies in the proportion of horses that were used primarily for pleasure, with Madigan and Bell (2001) reporting a lower proportion in their study (chi-square = 17.74, $p<0.001$). There were no significant differences between the two studies with respect to headshaking characteristics, see Table 4.1.

4.4.1.3 Referral study from the UK (Lane and Mair 1987) compared to a self-selected survey from the UK (Mills *et al.* 2002a)

There was a significant difference between these two studies in the proportion of horses that were classified as thoroughbreds, with Mills *et al.* (2002a) reporting a higher proportion in their study (chi-square = 13.35, $p<0.001$), see Table 4.1. There was also a significant difference between the studies in the proportion of horses that were used primarily for pleasure, with Mills *et al.* (2002a) reporting a higher proportion in their study (chi-square = 22.12, $p<0.001$).

There were also significant differences between the two studies with respect to the proportion of horses reported with *rubbing the muzzle on objects* (chi-square = 16.32, $p<0.001$), *snorting* (chi-square = 23.55, $p<0.001$) and deteriorating on *bright sunny days* (chi-square = 23.40, $p<0.001$). In all three cases Mills *et al.* (2002a) reported a higher proportion of horses affected in their study, see Table 4.1.

4.4.1.4 Referral study from the USA (Madigan and Bell 2001) compared to a self-selected survey from the UK (Mills *et al.* 2002a)

There was a significant difference between these two studies in the proportion of horses that were used primarily for pleasure, with Mills *et al.* (2002a) reporting a higher proportion in their study (chi-square = 99.71, $p<0.001$), see Table 4.1.

There was also a significant difference between the two studies with respect to the proportion of horses reported with acting like a '*bee flew up the nose*' (chi-square = 10.57, $p = 0.001$), with Madigan and Bell (2001) reporting a higher proportion affected, see Table 4.1. There was also a significant difference between the two studies with respect to the proportion of horses reported to improve at *night* (chi-square = 15.57, $p<0.001$), with Mills *et al.* (2002a) reporting a higher proportion.

4.4.1.5 Self-selected survey from the UK (Mills *et al.* 2002a) compared to a self-selected survey from the UK (Q2000, Chapter 3)

There was a significant difference between these two studies in the proportion of horses that were used primarily for pleasure, with Mills *et al.* (2002a) reporting a higher proportion in their study (chi-square = 22.88, $p<0.001$), see Table 4.1.

There was also a significant difference between the two studies with respect to the proportion of horses reported to improve at *night* (chi-square = 28.01, $p<0.001$), with Mills *et al.* (2002a) reporting a higher proportion, see Table 4.1.

4.4.2 Estimation of the male: headshaker odds ratio

Information on the number of horses in the yard or field where the headshaker in question was kept was provided by 192 owners. (Four yards held more than one headshaker that had participated in the survey and their details were not replicated). This resulted in a total of 1886 horses reported to live on 188 UK yards. The mean yard held 10 horses (SD: 11.1, median 5 horses, range 1 to 70). 13 owners (7%) kept the horse on its own.

The ratio of male to female horses in the yard sample was 1.4:1, see Table 4.2. The ratio of males to females in the headshaker sample was higher at 1.8 males to 1 female. The odds ratio suggests that, given this male:female ratio in the normal UK horse population, males may be slightly more likely to be headshakers than females (odds ratio; 1.30, 95% CI. 0.96; 1.77), but the association between sex and sample is not a significant one (chi-square = 2.96, DF = 1, p = 0.085).

Table 4.2. The percentage of male and female horses reported in Q2000, out of the total horses in the yard and of the headshakers.

Horse sample	Total *N*	Male	Female	Ratio M:F
Horses in yard	1886	58% 1088	42% 798	1.4:1
Headshakers	200	64% 128	36% 72	1.8:1

4.5 Discussion

There was a lot of similarity in the reported headshaking characteristics between the four surveys, despite the differences in selection of subjects (diagnosis by a veterinary surgeon or self-selection), method of data collection (veterinary case reports or questionnaire-based surveys) and location of the horses (UK and USA). There was no significant difference in the reported prevalence of *vertical headshaking* and seasonality between the surveys. This is consistent with the hypothesis that the studies are measuring a similar headshaking phenomenon, which is interesting given the differences in the proportions of horses used primarily for pleasure in the studies. There was a significant difference in the proportion of horses reported with *snorting*, *rubbing the muzzle on objects* and deterioration on *bright sunny days* in the referral study of Lane and Mair (1987) and the self-selected questionnaire of Mills *et al.* (2002a). This may suggest a genuine difference in the presentation of the condition between these horses or it may reflect a tendency for horse-owners to 'over report' when faced with a questionnaire. It may equally reflect a tendency for veterinary surgeons to 'under report' without the benefit of reference to a predetermined list of characteristics.

An association with *bright, sunny days* and seasonality with the headshaking was commonly reported in all the surveys. Many of the horses in the US study by Madigan and Bell (2001) were reported to benefit from ocular protection from the sun (60%). However, face masks have been reported to be less effective at preventing headshaking attacks in UK horses (Mills *et al.* 2002b) so one might have expected the association between headshaking and *bright, sunny days* in these horses to be weaker. This might imply that, although presentation of the condition is similar, the mechanism causing the horse to headshake may be different. However, a lower proportion of horses in the UK sample by Mills *et al.* (2002) were reported to improve at *night*, which might suggest that this characteristic is more discriminative than the association with deterioration with *bright, sunny days*. A more detailed approach to the symptomatology of the horses may highlight other signs or associations with more discriminatory power than the basic signs that were compared between these studies.

All surveys reported a relatively high proportion of thoroughbreds in their samples (16%–41%). Lane and Mair reported a significantly lower proportion of thoroughbreds in their survey than Mills *et al.* (2002a) and Madigan and Bell (2001). However, in Lane and Mair's survey thoroughbred crosses may have been included as 'hunter types' (54% of their sample). Madigan and Bell (2001) calculated that thoroughbreds were three times more likely to be headshakers using their small control sample. A bias for thoroughbreds in headshaker populations has been noted previously by Cook (1979a, 1992). He suggested that their highly-strung temperament might make them less likely to be able to cope with any irritation. However, the proportion of thoroughbreds in the surveys summarised here is not dissimilar to that reported in the survey of horses in the north of England and Scotland by Mellor *et al.* (1999–30%). This might suggest that, in the UK at least, the apparent tendency for thoroughbreds to be more likely to be headshakers is unfounded. A risk factor analysis similar to that described in this chapter to look at the apparent sex bias may be required before any further speculation is given to this connection.

All four surveys of headshakers reported the presence of more males than females. This bias was most pronounced in the referral studies of Lane and Mair (1987) and Madigan and Bell (2001), where nearly three males to every one female headshaker were reported. However, the male: headshaker odds ratio calculated using horses from the UK Q2000 survey was much smaller (odds ratio 1.3) than that calculated by Madigan and Bell (odds ratio 2.2) and the association between sex and being a headshaker was not found to be significant. Strictly speaking, their odds ratio related to geldings: non geldings; however the proportions of stallions in any of the surveys was very low and is unlikely to explain the discrepancy between survey results. The male to female ratio of the headshaker sample in Q2000 was less skewed towards males than Madigan and Bell (2001) and the non-affected horse sample was also slightly biased towards males. The size of Madigan and Bell's control sample of non-affected horses was very small, 39 horses, which might explain the conflicting results in the two surveys. However, the largest survey of US horses to date estimated the percentage of males in the adult horse population to be around 50% (NAHMS 1998), so the male bias in their sample may not be a reflection of the normal population.

Bias towards male horses in the surveys described here may be more a reflection of the referral process than any direct relationship between sex and headshaking. It has been reported that there is a preference towards male horses for various disciplines and that males tend to outperform females (Murphy *et al.* 2004). If this is the case then male horses may be more valuable to the owner, and one might expect to find more of them in the referral clinic, all other factors being equal. Indeed this does seem to be the case for another problem affecting performance, laryngeal paralysis, for which there is also no explanation why males may be more likely to be affected (Dixon *et al.* 2001). Differences the proportion of horse used primarily for pleasure between the referral studies and the questionnaire based surveys might support this assertion.

Chapter 5

Part II

A survey of 200 UK headshakers:

3. The reported prevalence of behavioural signs

5.1 Introduction

To date, a comprehensive record of the reported signs in headshakers has not been offered. With the exception of Mills *et al.* (2002a), the majority of studies have summarised the presentation of signs in each horse in the study rather than reporting the prevalence of signs in the whole sample from a predefined list. As a consequence of this, non-report cannot be treated as absence of the sign and patterns of presentation of the syndrome may not be properly compared between studies. For example, discrepancies between the proportion of horses reported with some of the headshaking signs in Lane and Mair (1987) and Mills *et al.* (2002a) (discussed in Chapter 4) may have reflected genuine differences between the horses or simply differences in the methods of recording the signs. This disparity has occurred partly because many of the case reports in the literature are not concerned with the idiopathic syndrome but also because no such list of signs has been generally adopted. Whilst it is generally established that headshaking, excessive rubbing of the nose and snorting are common 'headshaking' signs (Madigan and Bell 2001) most papers have also reported other signs which may or may not be part of the syndrome. For example, authors have listed attempts to hide the head (Madigan *et al.* 1995), head pressing (Newton *et al.* 2000), clamping the nostrils (Newton *et al.* 2000), excessive blinking (blepharospasm, Cook 2003) and difficulty in bridling (Cook 2003).

A repeat survey using a complete list of all the signs mentioned in the literature would enable the formation of a more accurate description of the syndrome, at least as it appears in horses considered to be headshakers by their owners. In the field of animal behaviour science, such a list is known as an 'ethogram' (Martin and Bateson 1993). It is a formal description of a species behavioural repertoire, which may be a complete list of all behaviours or a just those associated with a given event or situation (Grier 1984). A complete ethogram for equids has recently been published which includes descriptions of play, agonistic and abnormal behaviour, including an attempt to describe the headshaking movement (McDonnell 2003). Ethograms not only record the description of behaviours for posterity but help to increase the consistency with which the behaviour is reported by researchers in other studies. Since, in the absence of any clinical evidence of disease, the presentation of headshaking syndrome is largely behavioural signs, an ethogram of the syndrome might be an appropriate method for recording the general features of the syndrome for use in the future.

The record of each headshaker's behavioural signs in recent studies has come from the owner, as opposed to a veterinary surgeon who is trained in the identification of signs indicative of a particular diagnosis. Mair *et al.* (1992) supported the use of the horse owner as the assessor of their horse's behaviour since their observation of the symptoms led to the horse to be presented to the surgeon for subsequent diagnosis. However, are horses that have not been diagnosed by a veterinary surgeon likely to be suffering from the same syndrome? A comparison of horse characteristics between the questionnaire-based survey of Mills *et al.* (2002a) and the case reports of Lane and Mair (1987) was made in Chapter 4. No substantial differences between the two studies were found, although the reporting of some signs was slightly higher in Mills *et al.* (2002a). Differences in method of data collection between the studies (owner recall versus veterinary attention to signs on perhaps only one occasion) may have accounted for these observed differences. One way of avoiding this would be to look at the reported prevalence of signs by their owners in horses that had been treated by a veterinary surgeon and those that had not. This is under the assumption, however, that a horse that has been treated by a veterinary surgeon for headshaking would be recognised as a headshaker by the veterinary surgeon in the same way as in the referral studies.

Perhaps as a result of their small sample size and incomplete recording of the signs, there has been no attempt to group the headshakers in published studies based on the presentation of their problem. Since it is unlikely that idiopathic headshakers are all suffering from the same disease (Cook 1979a), this is an important step to make if advances in the diagnosis and treatment of the syndrome are to be made. An attempt was, however, recently reported in Mills *et al.* (2002a) using two methods. Firstly, the authors looked for differences in presentation of the syndrome between horses that were reported to suffer in the spring/summer months only and those that were reported to suffer all year round. However, the seasonality grouping of the horses was obtained from owner report in an open-ended section of the questionnaire. This raises the possibility that horses that were affected all year round but were worse in the summer (perennially affected but with seasonal exacerbations, see Section 3.3.3.3) could have fallen into the seasonal or non seasonal category depending on the owner's perceptual bias. A more systematic approach to this feature of the condition would prevent this by, for example, asking the owner to report on the occurrence and severity of the headshaking each month of the year. Using a repeated but updated survey to look again for associations between seasonality and presentation and history of the problem might therefore be worthwhile.

Mills *et al.* (2002a) also attempted to differentiate between headshakers using a principal component analysis of 11 behavioural signs. Although 60% of the variation in the data could be explained by reducing the number of explanatory variables by over a half, describing these new composite variables proved difficult. The authors used only a small list of signs with binary responses to each (presence of sign, yes or no). The resulting dataset was perhaps too crude for multivariate techniques to produce a meaningful output. Creating scores for the number of situations under which the horse is reported to present with each sign would not only increase the variability in the data but provide important information regarding the relative occurrence of the signs. For example, it is often assumed that the majority of headshaking occurs when the horse is being exercised and that other signs such as rubbing occur following exercise (Lane and Mair 1987). However, a significant proportion of horses are reported to be affected 'at rest' (42%–Lane and Mair 1987; 55%–Madigan and Bell 2001; 41%–Mills *et al.* 2002a). How the syndrome presents 'at rest' and how this differs from 'at exercise' is therefore of interest, especially if this might help to distinguish between horses.

Searching for factors that are predictive of successful treatment (prognostic factors) can help increase our understanding of the causes of a disease (Pocock 1991). This technique has not been reported much in the veterinary literature on headshaking, probably as a consequence of the poor response to treatment and the use of small samples. One management aid (the nose net) has, however, consistently been reported to be particularly successful at preventing attacks, both in reports of owners (Mills *et al.* 2002b and Q2000, see Section 3.4.9.1) and in a field study (Mills and Taylor 2003). In the latter, the authors looked at the prognostic value of several factors for 50% improvement with the nose net. However, they found little evidence of association between age of the horse, sex, known duration of the problem and initial severity and success of the nets.

The apparent failure by Mills and Taylor (2003) to find any significant factors associated with the efficacy of the nose net may have been due to the small sample size available relative to the potential number of prognostic factors. One way of increasing the sample size may be to utilise the reports of nose net efficacy from a survey. Mills and Taylor (2003) did not find any significant differences in the efficacy of three types of net in a repeated measures trial. This suggests that, although survey respondents would not have tried a nose net under controlled conditions, the variation in reported efficacy between types of nets might be relatively small. Logistic regression could then be applied to identify factors predictive of the reported response to the nose net. This method is commonly used in clinical medicine. It provides an equation describing the nature of the relationship between ordinal or binary variables (Drew *et al.* 1999). It has been used, for example, to identify individual risk factors for compulsive behaviours in the horse (Luescher *et al.* 1998).

5.2 Aims

1. To produce a survey in order to establish the reported prevalence of a range of clinical signs and the state of exercise under which they are reported to occur in a sample of British horses considered by their owners to have a headshaking problem
2. To produce a descriptive ethogram of the major signs associated with headshaking syndrome
3. To test the null hypothesis that there is no difference in the reported prevalence of headshaking signs in horses that have been treated by a veterinary surgeon for headshaking and those that have not
4. To evaluate the differences in symptomatology between different seasonal types of headshaker
5. To classify headshakers according to their reported symptomatology (using principal component analysis and cluster analysis)
6. To evaluate the extent to which the reported symptomatology of the headshaking condition can predict the reported response to a nose net (using results from a principal component analysis, k-means cluster analysis and ordinal logistic regression)

5.3 Methods

5.3.1 Survey questionnaire

A list of 26 signs (plus 'other') was drawn up from those reported in other headshaking case studies and surveys (see Table 1.1) and from those volunteered by owners in Q1998 (Mills *et al.* 2002a). This list was included in the survey described in Chapter 3 (Q2000), see page 5 of Appendix III. The choice and wording of signs focussed on clarity and avoidance of ambiguity and repetition. For example, 'rubbing the nose on the ground when in motion' and 'rubbing the nose on the ground when stationary' in Q1998 was changed to *dropping the nose to the ground*, since it is both difficult to assess whether the horse is in motion or stationary when this occurs and whether the nose is actually being rubbed along the ground (pers. obs.). For each of the signs, the owners were requested to indicate, by placing a tick, if their horse showed the sign 'when stabled', 'when grazing', 'when being ridden' and/or 'after being ridden'. They were also asked additional questions regarding whether the horse ever attempted to hide its head (from the sunlight) and whether they felt that it had a sensitive head area. From February 2001, new recruits to the survey were also asked if the horse acted like 'a bee had flown up the nose' (in the four situations) and how difficult it was to bridle the horse (very easy, easy, hard to say, difficult or very difficult). Finally, owners were encouraged to submit video footage of their horse headshaking for further analysis and creation of the ethogram.

5.3.2 Summary statistics

The percentage of horses reported with each of the 27 signs was calculated from the total number of completed questionnaires (subject to selection criteria, see Section 3.3.2). The percentage out of the total that had been reported with the sign 'when stabled', 'when in the field', 'when being ridden' and 'after being ridden' was also calculated. The percentage of the horses that had been reported to 'act like a bee had flown up their nose', to attempt to hide their head, to have a sensitive head area and be difficult to bridle was also calculated. Finally, the total number of signs each horse was reported with was calculated and the average for the survey presented.

5.3.3 Production of the ethogram

A description of those behaviours that were reported with over 25% prevalence in the survey was made. More 'subjective' terms, e.g. *stumbling,* were not included. Descriptions were created from observations of over 50 headshakers from videos submitted to the researcher or during visits to horses over the course of the study. Descriptions included the common pace of the horse when the behaviour occurs (e.g. walk, trot, canter or standing) and other names for the behaviour offered by other researchers. An estimation of the prevalence of each of the behaviours, in horses described under the general term of 'headshaker', was given by averaging the reported prevalence of the behaviour from this study and those listed in Table 1.1.

5.3.4 Statistical analyses

5.3.4.1 Relationship between the total number of reported signs per horse and reported severity grading of the headshaking

Horses were given a score for severity based on their owner's response to Q12 in Q2000 (see Appendix III) which related to the horse's headshaking 'when at its worst'. Barely noticeable' scored 1, 'annoying, but bearable' scored 2, 'unpleasant, and difficult to control' scored 3 and 'dangerous, and the horse is unrideable' scored 4. The relationship between the total number of signs reported in each horse and the reported severity score for the horse's headshaking 'when at its worst' (Q 12, see Appendix III) was evaluated using Spearman's rank correlation. This gives the correlation coefficient, r_s, which describes the strength and direction of the relationship between the two variables and the p-value which describes the statistical significance of the relationship.

5.3.4.2 Difference in reporting of behavioural signs in horses that have been treated by a veterinary surgeon for headshaking and those that have not

The reported prevalence of all listed signs was compared between horses whose owners reported that they had sought veterinary treatment for the headshaking problem (N=81) and those that did not report any seeking of assistance (either treatment or advice, N=52) (Questions 52 and 53 on the questionnaire). The percentage of horses reported with each of the signs was compared using a chi-square test of association (SAS v 8.0, SAS Institute, Inc). The difference between those two groups with regard to the total number of signs that the horses on average were reported with (out of a possible 27) was compared using a 2-sample t-test.

5.3.4.3 Differences in reported prevalence of signs and factors between seasonality types

The number of horses reported with each of the 27 behavioural signs listed was compared among the groups of horses that were reported to headshake only seasonally (*N*=98), perennially with seasonal exacerbations (*N*=39) and perennially (*N*=15), see Section 3.3.3.3 for definitions. The proportion of horses reported with the sign was compared between these three seasonality types using the chi-squared test of association (SAS v 8.0, SAS Institute, Inc). Using this method, the proportion of horses was also compared across seasonality types for the following factors listed in Q2000 (see Appendix III):

- Hiding the head (Q28, yes or no)
- Sensitive in the head area (Q29, yes or no)
- Sex (gelding or not)
- Breed (thoroughbred or not)
- Pleasure use only (owner ticked this option only, or not)
- Success with a nose net (Q58, substantial or complete success with nose net, or not)
- Owner reported that the headshaking was worse under these situations (yes or no):
    - When horse was feeling nervous (Q30)
    - When horse was feeling excited (Q31)
    - As exercise progressed (Q33)
    - On bright, sunny days (Q34)
    - In a cloud of midges (Q40)
    - On warm days (Q41)
    - In the rain (Q42)
    - In wooded areas (Q43)

The Kruskal-Wallis test was used to test the significance of the difference between seasonality types for median length of time that the horse had been headshaking for (in years, Q7), the horse's age at the first reported onset of the problem (Q9) and the reported severity score for the headshaking when the horse is 'at its worst' (Q12).

5.3.4.4 Multivariate analysis of headshaking signs

For every horse, each of the 27 signs listed was given a score from 0–4 according to the number of situations in which the owner had reported that the sign occurred. A sign received a score of 4 if it was reported to occur 'when stabled', 'when grazing', 'when being ridden' and 'after being ridden' and a score of 0 if none of these situations had been indicated.

A principal component analysis was conducted on the correlation matrix of the scores for 27 signs from 200 horses. This is a method of data reduction, achieved by the construction of new variables that are linear combinations of the original variables in the data set (Everitt and Dunn 1991). These new variables are uncorrelated, and therefore measure different dimensions in the data (Manly 1986). As many new variables (principal components) as there were original variables are produced using this technique. However, they are derived in decreasing order of importance, so that the first component accounts for as much as possible of the variation in the original data and each subsequent component explains the maximum possible that has not been accounted for by the previous components. The influence of each of the original variables (the signs) within each component is described by the size of its correlation coefficient, also called its loading. Variables that have loadings of an absolute value greater than 0.2 are generally considered to be influential in the component (Everitt and Dunn 1991). The loadings for the first two principal components are presented together with a plot of the scores for each horse from these first two components. The bi-plot also shows the relationship between the 'loadings' of each of the signs in the first two components.

A divisive hierarchical cluster analysis (algorithm: diana, S-Plus 2000, Mathsoft Inc) was then conducted on the scores from the first seven principal components in a method similar to that used by Joliffe *et al.* (1982). The first seven components in total explained 55% of the variation in the data, each with eigenvalues greater than 1.2, indicating that each explains more variation in the data than one variable alone. Inclusion of subsequent components did not improve on this sufficiently to warrant their inclusion. Cluster analysis is a method for dividing a dataset into groups (clusters) of observations that are similar to each other. The diana-algorithm constructs a hierarchy of clusterings, starting with one large cluster containing all observations (Kaufman and Rousseeuw 1990). Clusters are divided until each of them contains only a single observation (i.e. horse). At each stage, the cluster with the largest diameter is selected. (The diameter of a cluster is the largest dissimilarity between any two of its observations, calculated as Euclidean distance). To divide the selected cluster, the algorithm first looks for its most disparate observation (i.e., which has the largest average dissimilarity to the other observations of the selected cluster). This observation initiates the 'splinter group'. In subsequent steps, the algorithm reassigns observations that are closer to the 'splinter group' than to the 'old group'. The result is a division of the selected cluster into two new clusters.

A dendrogram was produced which illustrates the hierarchy of the clustering of the horses. This was then used to suggest how many clusters the horses might 'naturally' fit into and therefore how many clusters should be created by means of a *k*-means cluster analysis, which is a non-hierarchical method (Everitt 1993). The *k*-means method is often employed for behavioural data since it imposes no hierarchical structure on the clusters (Greenwood *et al.* 2000). The median scores for each of the 27 signs, together with the median severity score (see Section 5.3.4.1) and median seasonality score (see Section 5.3.4.5) were then presented for each of the clusters produced by *k*-means cluster analysis.

5.3.4.5 Predicting response to a nose net using multivariate analysis of symptomatology

The outcome with a nose net was reported by 176 owners in the survey (see Table 3.7). Their reports were converted into a score from 0 to 3 (0 = no effect, 1 = partial, 2 = substantial and 3 = complete).

The score for each horse for the first component from the principal component analysis described above was derived. Only the first component was used since this explained much more variation than any other component. Using more components to describe the horses would make interpretation difficult without significantly increasing the proportion of variance explained. Horses were grouped into two groups according to their position above or below the median for this score. The mean score for the success of the nose net was then compared between these two groups using a 2-sample t-test.

The median score for success with the nose net was also compared across the cluster groups formed from the k-means cluster analysis described above, using the Kruskal-Wallis test.

Finally, an ordinal logistic regression model (Minitab v 13.3, Minitab Inc., USA) was fitted to the outcome of the nose net (0-3) and selection of symptomatology scores. This is a nonlinear regression method for predicting an ordinal dependent variable. Only a few signs were chosen in order to increase the reliability of the model. Signs were chosen for their inclusion based on their apparent importance in previous models. Composite scores were created from some pairs of signs that correlated positively together ($p<0.001$) and were considered to be measuring the same or interdependent behavioural phenomenon. In addition, a score for the seasonality of the horse's headshaking and severity were included as described below since they were considered to describe an ordinal pattern of increasing severity or occurrence. All the factors included in the model are listed below, with the range of their scores:

- *Vertical headshaking* (0–4)
- *Dropping nose to the ground* (0–4)
- *Clamping the nostrils* (0–4)
- *Flipping the nose* (0–4)
- *Snorting* (0–4, average score for *snorting* and *sneezing* to nearest integer)
- *Rubbing nose* (0–4, average score for *rubbing nose on objects* and *on foreleg*)
- *Striking* (0–4, average score for *striking out* and *striking at nose*)
- Seasonality score (1 = sunny seasonal, 2 = perennial with seasonal exacerbations, 3 = perennial; horses not fitting into one of these patterns were excluded, $N=5$)
- Severity score (1–4)

5.4 Results

5.4.1 Reported prevalence of behavioural signs associated with headshaking syndrome

5.4.1.1 Reported prevalence of signs when the horse is 'stabled', 'grazing', 'being ridden' and 'after being ridden'

Reports of the behavioural signs of their horse's headshaking problem were available from 200 horse-owners. Table 5.1 lists the signs reported by over 40% of owners. *Vertical headshaking* was reported to occur in 93% of horses. In addition, *rubbing the nose on the foreleg, rubbing the nose on objects* and *snorting* were reported in over 80% of horses. *Sneezing* was the next most commonly reported sign (61%) followed by *striking out with the foreleg* (55%), *dropping the nose to the ground* (55%), *nasal discharge* (50%), *flipping the nose/top lip* (48%), *striking of the foreleg onto the nose* (43%) and *twisting or rotary headshaking* (43%). The colour of the nasal discharge was usually reported to be white or clear, sometimes the owner reported both colours.

Table 5.1 also shows the percentage of horses (out of those that exhibited the sign) that were reported to suffer 'when stabled', 'when grazing', 'when ridden' and 'after being ridden'. The majority of signs were most often reported to occur when the horse was 'being ridden', with few exceptions. *Vertical headshaking* was reported to occur 'when being ridden' in 97% of cases, but was also reported to occur in 42% of horses 'when grazing'. For those horses reported with the sign, *nasal discharge* was reported to occur in over 50% 'when stabled' and 'after being ridden' as well as when 'being ridden'. *Rubbing the nose on objects* or *rubbing the nose on the foreleg* was also reported to occur 'after exercise' in over 50% of horses with the sign and in a significant proportion at other times.

Table 5.1. The behavioural signs reported with over 40% prevalence (*N*=200). The prevalence of each sign when the horse is stabled, grazing, ridden and after being ridden is also given (out of those reported with the sign). Signs are listed in descending order of overall prevalence. Shaded cells indicate the state(s) that 50% or more of the horses were in when they exhibited the sign.

Behavioural sign	Total *N*	Occurs when: stabled	grazing	being ridden	after riding
Vertical headshaking	185 93%	41 22%	77 42%	180 97%	53 29%
Rubbing nose on foreleg	163 82%	32 20%	67 41%	141 87%	92 56%
Rubbing nose on objects	161 81%	68 42%	78 48%	108 67%	96 60%
Snorting	161 81%	39 24%	57 35%	152 94%	41 25%
Sneezing	122 61%	36 30%	42 34%	114 93%	30 25%
Striking out of foreleg	110 55%	12 11%	26 24%	103 94%	17 15%
Dropping nose to the ground	109 55%	13 12%	34 32%	99 91%	29 27%
Nasal discharge[1] ***Clear/ Yellow/ White***	100 50%	54 54%	33 33%	54 54%	52 52%
Flipping of top lip/nose	96 48%	35 36%	37 39%	81 84%	38 40%
Striking of foreleg onto nose	86 43%	9 11%	23 27%	83 97%	17 20%
Twisting/rotary headshaking	86 43%	4 5%	23 27%	80 93%	7 8%

[1] *93 owners described the colour (some gave more than one); white (57, 61%), clear (41, 44%), yellow (6, 6%)*

Table 5.2 lists the signs reported by less than 40% of the owners. *Horizontal headshaking* (31%) was less commonly reported than *vertical headshaking*. *Rushing* (36%), *stumbling* (34%), being *unwilling to move* (30%) or having an *odd head carriage* (29%) were often reported as part of the problem but not by the majority of owners. Approximately one quarter of owners reported signs of coughing, watering eyes, twitching and sweating. Areas that were reported to twitch were the muzzle/nose (23 comments), head (7), body (5), eye area (2), ears (2), shoulders (2), face and tail (1 comment each). Sweat patches were reported to appear on the neck (26 comments), girth area (10), all over (7), behind the ears (7), on the face (7), flanks (6), chest (6), under the saddle (5), groin (4) and shoulders (4).

Clamping the nostrils was not often reported (17%) neither was *staring into space* (14%) or *blinking* (9%). *Signs of inflammation* were reported on the nostrils (11 comments), nose/muzzle (7), eyes (4), face (2), skin (2), lips, lymph glands, guttural pouches (1 comment each). Other signs reported were; rearing (4), shying (4), stepping sideways or spinning around (4), putting nose in water (2), in straw (1), in bushes (1), against back stable wall (2), stamping feet (2), napping (2), ear waggling (2), squinting, photosensitivity, shortened strides, ocular discharge, raised veins around face, fitting, wheezing, inability to graze normally, squeaking, pollakiuria (1 report each).

The less commonly reported signs were most often reported to occur when the horse was being ridden. However, *twitching*, *watering eyes*, *signs of inflammation* and *blinking* were reported in over 50% of the horses with the sign 'when grazing' as well as 'when being ridden'. *Heavy eyelids* and *staring into space* were less commonly seen 'when being ridden' than at other times.

Table 5.2. The behavioural signs reported with less than 40% prevalence (N=200). The prevalence of each sign when the horse is stabled, grazing, ridden and after being ridden is also given (out of those reported with the sign). Signs are listed in descending order of overall prevalence. Shaded cells indicate the state(s) that 50% or more of the horses were in when they exhibited the sign.

Behavioural sign	Total N	Occurs when: stabled	grazing	being ridden	after riding
Rushing forward	71 36%	4 6%	13 18%	64 90%	5 7%
Stumbling	68 34%	1 1%	9 13%	64 94%	5 7%
Horizontal headshaking	62 31%	9 15%	18 29%	56 90%	14 23%
Coughing	61 31%	23 38%	9 15%	47 77%	6 10%
Unwillingness to move	60 30%	1 2%	9 15%	54 90%	4 7%
Odd head carriage	57 29%	4 7%	12 21%	52 91%	5 9%
Sweating[1]	50 25%	5 10%	8 16%	45 90%	9 18%
Odd/heavy breathing	49 25%	10 20%	9 18%	40 82%	14 29%
Watering eyes	48 24%	21 44%	38 79%	29 60%	18 38%
Twitching[1]	45 23%	20 44%	25 56%	40 89%	17 38%
Heavy eyelids	43 22%	27 63%	22 51%	18 42%	24 56%
Clamping the nostrils	33 17%	14 42%	13 39%	28 85%	11 33%
Other[1]	31 16%	10 32%	7 23%	22 71%	4 13%
Staring into space	28 14%	17 61%	14 50%	5 18%	10 36%
Signs of inflammation[1]	26 13%	10 38%	17 65%	19 73%	12 46%
Blinking	18 9%	4 22%	12 67%	9 50%	6 33%

[1] *see text for elaboration*

5.4.1.2 Reported prevalence of 'acting like a bee flew up the nose' (N=50)

Of the 50 owners who were asked the question, 'does the horse act like bee flew up its nose?' 37 (74%) reported that it did, with 35% of these reporting that it occurred most often. 19% reported that the horse acted like bee flew up its nose when stabled, 35% when grazing, 100% when it was being ridden and 16% after being ridden.

5.4.1.3 Reported prevalence of attempts to hide the head

36% of owners said that their horse attempts to hide its head from the sunlight (out of 174 owners that could answer). 62 of the 63 indicated how the horse did this:

- Putting its head under another horse's tail or body (17 comments)
- Standing in the corner of stable with its head lowered (16)
- Putting its head against the owner's back or under their armpit (14)
- Putting its head in a bush, long grass, in its water trough or its bedding (14)
- Lowering or turning its head away (10)
- Preferring to stand with at least its head in the stable than being outside (9)
- Holding its head against a stationary object (7)

5.4.1.4 Reported prevalence of hypersensitive areas on the head

46% of owners said that they believed their horse was sensitive in the muzzle, poll or facial areas (i.e. it disliked being touched in these areas) (out of 196 owners that could answer). When asked to specify, the owners particularly mentioned:

- Difficulty in brushing/touching; the poll/ears (26 comments), the face/head (21) or the muzzle (17)
- That the horse didn't like small, airborne objects (e.g. flies or falling leaves) around; the face/head (23) or the muzzle (21)
- Difficulty in being bridled (14)
- That the horse was prone to sunburn on the muzzle (2)

5.4.1.5 Reported difficulty in bridling (N=50)

Over 80% of the horses were reported to be at least 'easy' to bridle. 41% (20) were reported to be 'very easy' to bridle, 41% (20) were reported to be 'easy' to bridle, 10% (5) were reported to be 'difficult' to bridle and 4% (2) were reported to be 'very difficult' to bridle. 4% (2) of owners found it 'hard to say' and 1 owner did not know.

5.4.2 Ethogram of headshaking behaviour

An ethogram of 13 behaviours; *vertical headshaking*, *rubbing the nose on the foreleg*, *rubbing the nose on objects*, *snorting*, *flipping the top lip*, *striking out of the foreleg*, *striking of foreleg onto nose*, *nasal discharge*, *dropping nose to the ground*, *rotary headshaking*, *horizontal headshaking*, *odd head carriage* and *hiding the head* was compiled. It is shown in Appendix IV.

5.4.3 Relationship between total number of signs reported and severity rating of the headshaking

Horses were, on average, reported with 11 of the 27 listed signs (SD 4.19, median 11 signs, range 2–24, N=200). There was a significant, positive association between the total number of signs reported in each horse and the severity rating of the headshaking, see Fig. 5.1 ($r_s = 0.42$, $p<0.001$, N=198). A correlation coefficient of 0.42 suggests that there is a tendency for those horses with more reported signs to be more likely to be considered to have a more severe problem but the relationship is not very strong.

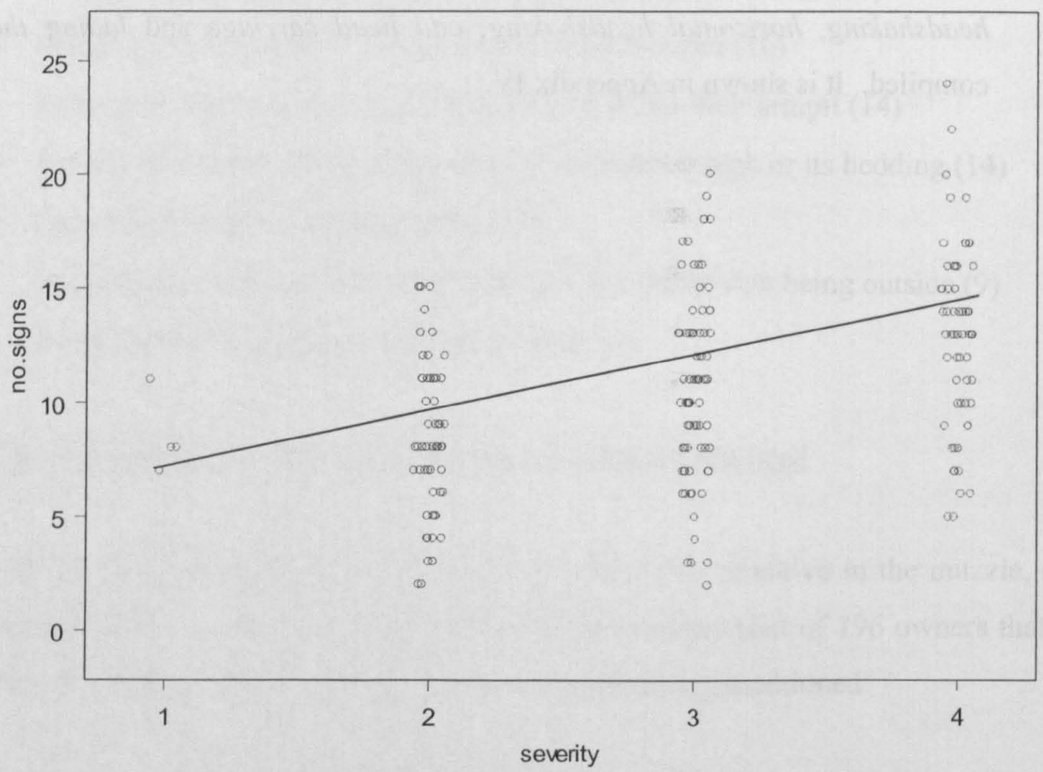

Fig. 5.1. The relationship between severity score (1–4) and the total number of signs the horse was reported to show (possible range 0–27). The line illustrates a linear correlation of $r_s = 0.42$, p<0.001, N=198). Points have been jittered to enable the frequency of horses at each severity score to be seen.

5.4.4 The reported prevalence of behavioural signs in horses that have been treated by a veterinary surgeon for headshaking and those that have not

There was no significant difference in the proportion of horses reported with three of the four most commonly reported signs; *vertical headshaking*, *rubbing the nose on the foreleg* and *snorting* (all above 80% prevalence) between horses that had been treated by a veterinary surgeon for headshaking and those that had not. However, there was a significant difference between these two groups of horses in the reported prevalence of 11 of the 27 signs, see Table 5.3. In all cases, the owners who had not consulted a veterinary surgeon were less likely to report the sign in their horse. In particular, owners who had not consulted a veterinary surgeon were less likely to report *dropping the nose to the ground* ($p<0.001$), *clamping the nostrils* ($p = 0.001$), *striking out of the foreleg* ($p = 0.007$) and *rubbing the nose on objects* ($p = 0.008$). There was little difference, however, in the ranked prevalence of the signs between horses that had been treated by a veterinary surgeon and those that had not seen one, with a few exceptions. *Flipping of the nose/top lip*, *rotary headshaking* and *coughing* were relatively more common in the group that had not consulted a veterinary surgeon and *dropping the nose to the ground* was relatively less common.

There was a significant difference in the mean total number of reported signs between horses that had been treated by a veterinary surgeon and those whose owners had not sought veterinary advice (2-sample t-test; $t = -4.62$, $DF = 131$, $p<0.0001$). The horses that had been treated by a veterinary surgeon were reported with 12 signs on average (median 12) compared to 9 (median 8) for those horses whose owners had not consulted with a veterinary surgeon.

Table 5.3 The reported (ranked) prevalence of behavioural signs by owners that reported seeking veterinary treatment for the headshaking problem (Vet: N=81) and those that did report seeking either advice or treatment (No vet: N=52). Chi-square tests of association between each group are shown together with the significance of the association, signs with p<0.05 are shaded.

Behavioural sign	Vet		No vet		Chi-square	p (exact)
Vertical headshaking	94%	(1)	96%	(1)	0.34	(0.704)
Rubbing nose on foreleg	86%	(2)	75%	(2)	2.79	0.095
Rubbing nose on objects	86%	(3)	67%	(4)	6.96	0.008
Snorting	84%	(4)	71%	(3)	3.12	0.077
Sneezing	65%	(5)	44%	(8)	5.81	0.016
Dropping nose to the ground	65%	(5)	35%	(10)	12.09	<0.001
Striking out of foreleg	64%	(7)	40%	(9)	7.25	0.007
Nasal discharge	59%	(8)	46%	(7)	2.19	0.139
Striking of foreleg onto nose	52%	(9)	37%	(11)	2.99	0.084
Flipping of top lip/nose	48%	(10)	48%	(5)	0.00	0.994
Rotary headshaking	41%	(11)	48%	(5)	0.69	0.405
Rushing forward/panicking	40%	(12)	23%	(15)	3.86	0.049
Unwillingness to move	38%	(13)	19%	(16)	5.38	0.020
Stumbling/in-coordination	37%	(14)	27%	(14)	1.46	0.226
Horizontal headshaking	32%	(15)	31%	(12)	0.03	0.872
Odd head carriage	31%	(16)	17%	(18)	3.06	0.080
Odd/heavy breathing	31%	(16)	19%	(16)	2.21	0.137
Watering eyes	31%	(16)	17%	(18)	3.06	0.080
Heavy eyelids/dopey expres"	30%	(19)	12%	(22)	5.93	0.015
Clamping the nostrils	28%	(20)	6%	(24)	10.31	0.001
Sweating	27%	(21)	15%	(20)	2.51	0.113
Twitching	26%	(22)	15%	(20)	2.06	0.151
Coughing	25%	(23)	29%	(13)	0.28	0.595
Other	21%	(24)	6%	(24)	5.74	0.017
Signs of inflammation	20%	(25)	10%	(23)	2.45	0.118
Staring into space	19%	(26)	6%	(24)	4.40	0.036
Blinking	12%	(27)	2%	(27)	4.53	(0.050)

5.4.5 Differences in reported prevalence of signs between seasonality types

There was no significant difference between the three seasonality types in the percentage of horses reported with the main headshaking signs, see Table 5.4. There was no significant difference for *vertical headshaking, snorting* or *sneezing, rubbing the nose*, presence of a *nasal discharge* or *striking out*. There was, however, a significant difference between the seasonality types with regard to percentage reports of *flipping the nose* ($p = 0.010$), *clamping the nostrils* ($p = 0.012$), *dropping the nose to the ground* ($p = 0.028$) and *striking at the nose* ($p = 0.042$). For the latter three there was an increase in reports as the seasonal pattern to the headshaking became less distinct. However, for *flipping the nose*, horses that were perennially affected with seasonal exacerbations were most likely to be reported with this sign ($p = 0.010$). There was also a non-significant trend for those that were perennially affected or perennially affected with seasonal exacerbations to be more likely to be reported to *cough* ($p = 0.090$) and *stumble* ($p = 0.098$). There was no evidence of any difference between the seasonality types in the percentage of horses reported to hide their face or to have a hypersensitive area, see Table 5.5.

There was no significant difference between the seasonality types with respect to sex of the horse, breed (thoroughbred or not) or use (purely pleasure or not). There was no evidence of a difference between the groups with respect to the reported effect of a nose net, see Table 5.5.

There were few differences between the seasonality types with regard to the percentage whose headshaking was reported to be provoked by various situations, see Table 5.5. In particular there was no difference between the groups for the effect of *bright, sunny days*, riding through a *cloud of midges* or riding through *wooded areas*. However, perennially affected headshakers were significantly more likely to be reported to be adversely affected by *rain* ($p=0.002$), *feeling excited* ($p = 0.014$) or *feeling nervous* ($p = 0.048$) than seasonal headshakers.

Table 5.4. The percentage of horses reported with each of the listed signs, out of those that were sunny seasonal, perennial with seasonal exacerbations and perennially affected. Signs for which there was a significant difference (p<0.05) in percentages between the seasonality types are shaded.

Sign	Sunny seasonal % (*N*=98)	Perennial +seasonal % (*N*=39)	Perennial % (*N*=15)	Chi-square	p
Vertical HS	95	97	93	0.57	0.752
Rubbing on foreleg	81	95	87	4.46	0.108
Snorting	80	92	80	3.28	0.194
Rubbing on objects	80	90	93	3.25	0.197
Sneezing	60	62	87	3.97	0.137
Nasal discharge	54	56	47	0.42	0.812
Striking out	51	59	67	1.67	0.430
Dropping nose	48	69	73	7.17	0.028
Rotary HS	45	46	40	0.17	0.919
Flipping nose	41	69	53	9.12	0.010
Striking at nose	39	56	67	6.34	0.042
Rushing	31	41	47	2.35	0.308
Odd head carriage	29	28	33	0.16	0.924
Coughing	29	46	47	4.82	0.090
Stumbling	28	38	53	4.65	0.098
Watering eyes	27	31	13	1.71	0.426
Horizontal HS	26	36	40	2.31	0.316
Odd breathing	26	23	27	0.11	0.945
Stopping	21	36	40	4.40	0.111
Sweating	20	31	40	3.59	0.166
Twitching	19	21	20	0.02	0.989
Heavy eyelids	18	26	13	1.36	0.506
Inflammation	15	10	7	1.24	0.539
Other	13	18	20	0.78	0.676
Blinking	10	5	13	1.20	0.549
Staring into space	9	15	13	1.16	0.561
Clamping nostrils	8	26	27	8.88	0.012

Table 5.5. The percentage of horses reported with each of the listed factors, out of those that were sunny seasonal, perennial with seasonal exacerbations and perennially affected. Factors for which there was a significant difference (p<0.05) in percentages between the seasonality types are shaded.

Factor	Sunny seasonal %	Perennial +seasonal %	Perennial %	Chi-square	P
Hides face	30 (26/88)	45 (15/33)	47 (7/15)	3.62	0.164
Hypersensitive area	40 (39/97)	54 (20/37)	47 (7/15)	2.12	0.347
Geldings	62 (61/98)	69 (27/39)	67 (10/15)	0.63	0.730
Thoroughbreds	32 (31/97)	32 (12/38)	40 (6/15)	0.41	0.815
Pleasure use only	30 (29/98)	31 (12/39)	47 (7/15)	1.77	0.412
Substantial effect of nose net	52 (46/88)	57 (21/37)	38 (5/13)	1.29	0.524
Provoked by:					
Feeling nervous	38 (28/73)	51 (18/35)	73 (11/15)	6.08	0.048
Feeling excited	46 (39/84)	47 (18/38)	87 (13/15)	8.54	0.014
As exercise progresses	61 (59/96)	68 (25/37)	80 (12/15)	2.12	0.347
On bright, sunny days	75 (69/92)	72 (26/36)	64 (9/14)	0.74	0.692
A cloud of midges or flies	87 (82/94)	90 (35/39)	100 (10/10)	1.53	0.466
On warm days	80 (69/86)	82 (28/34)	55 (6/11)	4.21	0.122
In the rain	13 (12/89)	22 (8/36)	60 (6/10)	12.79	0.002
Through wooded areas	79 (66/84)	78 (25/32)	67 (8/12)	0.86	0.649

There was a trend for a difference in median severity score when the horse was 'at its worst' between seasonally affected, perennially affected with seasonal exacerbations and perennially affected horses (Kruskal-Wallis test statistic = 5.07, DF = 2, N = 152, p = 0.079). The Mann-Whitney test revealed that there was a significant difference only between seasonally affected and perennially affected horses, with perennially affected horses reported to be worse on average, although the median score for all three seasonality types was the same (3 on a scale from 1–4) (Mann-Whitney test, W = 1082.0, N seasonal = 98, N perennial = 15, p = 0.042, adjusted for ties).

There was no evidence of a statistically significant difference between the three seasonality types with regard to reported age of the horse at the onset of the headshaking problem (Kruskal-Wallis test statistic = 1.14, DF = 2, N = 144, p = 0.567) nor how long the horse had been reported to have been headshaking for (Kruskal-Wallis test statistic = 0.27, DF = 2, N = 144, p = 0.875).

5.4.6 Multivariate analysis of headshaking signs

5.4.6.1 Principal component analysis

A principal component analysis on the correlation matrix of the 27 listed signs, scored from 0–4, for 200 horses was conducted. The first component explained 22% of the variation in the data and the second component only 7%. Subsequent components explained progressively less variance in the data, with no relatively large decrease in the proportion of variance explained between these remaining components. For clarity, the loadings on each sign for the first two components only are shown in Table 5.6. The first component loads most heavily on the most common headshaking signs; *vertical headshaking, snorting, sneezing, rubbing the nose on objects, rubbing the nose on the foreleg, flipping the nose, striking nose with foreleg, striking out, dropping the nose to the ground*, together with a *nasal discharge.* The second component loads negatively on some signs of nasal irritation (*nasal discharge* and *rubbing the nose on objects*) and positively on more subjective, behavioural features such as *stopping* and *rushing*, and other behaviours that were not commonly observed, e.g. *clamping the nostrils, heavy eyelids* and *staring into space.*

Fig. 5.2 plots the scores for the horses from the first two principal components. This figure represents approximately 30% of the variance in the data set. The majority of horses are clumped together, generally with low scores for the first component. This suggests that there is not much differentiation between the horses using the first two components. One horse, number 74, was particularly dissimilar to the other horses, scoring highly for component 2. The loadings of the signs are superimposed on the plot to demonstrate the strength and direction of their influence in the first two components. Signs of nasal irritation such as *snorting, rubbing the nose on objects, rubbing the nose on the foreleg* and *nasal discharge* all load positively and similarly in the first component. However, they are not related, being positioned at 90 degrees, to those signs that load heavily in the second component, for example, *rushing, stopping, heavy eyelids, clamping the nostrils* and *staring into space.*

Table 5.6 The loadings of the first two principal components from an analysis of the correlation matrix of scores of 27 signs from 200 horses. Signs with absolute correlation coefficients greater than 0.2 are shaded for each component

Sign	PC 1	PC 2
Vertical headshaking	0.24	0.06
Horizontal headshaking	0.07	–0.13
Rotary headshaking	0.12	–0.10
Odd head carriage	0.11	0.06
Flipping the nose	0.27	–0.10
Snorting	0.30	–0.11
Sneezing	0.27	–0.09
Rubbing the nose on objects	0.29	–0.21
Rubbing nose on the foreleg	0.31	–0.15
Dropping the nose to ground	0.25	–0.08
Striking nose with foreleg	0.21	–0.13
Striking out with foreleg	0.24	0.13
Clamping the nose	0.17	0.34
Coughing	0.13	–0.17
Odd breathing	0.13	0.09
Signs of inflammation	0.14	–0.13
Sweating	0.10	0.07
Nasal discharge	0.20	–0.30
Twitching	0.14	0.02
Watering eyes	0.18	–0.09
Blinking	0.16	–0.01
Heavy eyelids	0.19	0.23
Staring into space	0.17	0.42
Stumbling	0.12	0.16
Rushing	0.17	0.32
Stopping	0.14	0.33
Other	0.04	0.30

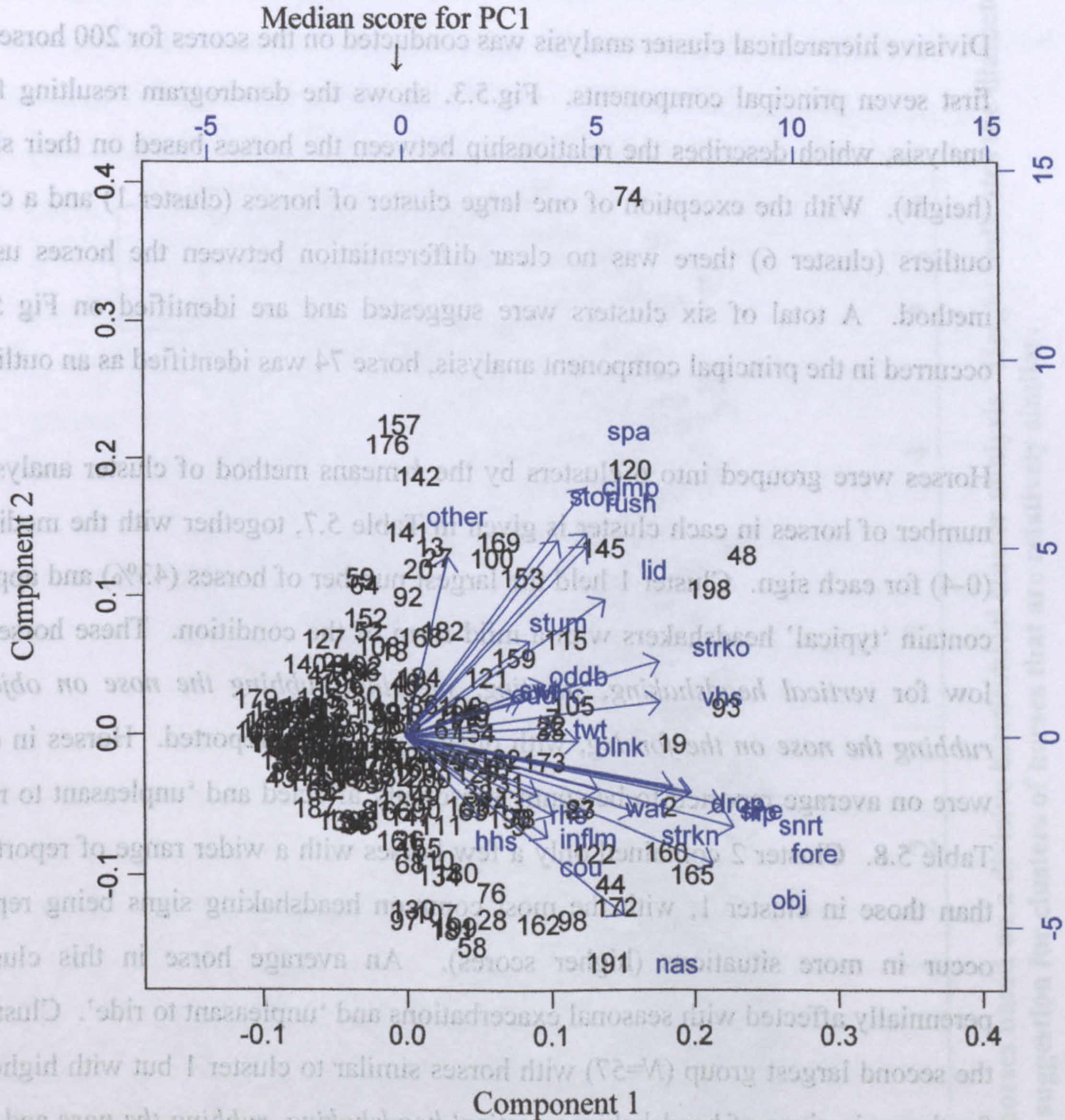

Fig. 5.2. The scores for each horse (shown by their number) for the first and second principal components from a principal component analysis of the reported presence of 27 signs in 200 horses. The top and right axes indicate the scores. The vectors are projections of the loadings on the first two components. The length of the vector indicates the size of the loading and the angle between vectors indicates the correlation between them. The bottom and left axes indicate the size of the loadings in each of the components.

5.4.6.2 Cluster analysis

Divisive hierarchical cluster analysis was conducted on the scores for 200 horses for the first seven principal components. Fig.5.3. shows the dendrogram resulting from the analysis, which describes the relationship between the horses based on their similarity (height). With the exception of one large cluster of horses (cluster 1) and a cluster of outliers (cluster 6) there was no clear differentiation between the horses using this method. A total of six clusters were suggested and are identified on Fig 5.3. As occurred in the principal component analysis, horse 74 was identified as an outlier.

Horses were grouped into 6 clusters by the *k*-means method of cluster analysis. The number of horses in each cluster is given in Table 5.7, together with the median score (0-4) for each sign. Cluster 1 held the largest number of horses (43%) and appeared to contain 'typical' headshakers with a mild form of the condition. These horses scored low for *vertical headshaking, snorting, sneezing, rubbing the nose on objects* and *rubbing the nose on the foreleg*, with other signs rarely reported. Horses in cluster 1 were on average reported to be sunny seasonally affected and 'unpleasant to ride', see Table 5.8. Cluster 2 contained only a few horses with a wider range of reported signs than those in cluster 1, with the most common headshaking signs being reported to occur in more situations (higher scores). An average horse in this cluster was perennially affected with seasonal exacerbations and 'unpleasant to ride'. Cluster 3 was the second largest group (N=57) with horses similar to cluster 1 but with higher scores for the main signs of headshaking; *vertical headshaking, rubbing the nose* and *snorting* and scores for *striking out with the foreleg* and a *nasal discharge*. Cluster 4 horses were reported with similar signs to those in cluster 1 but seemed to be the most severely affected group scoring highest for the main headshaking signs. There were only five horses in this group, including the outlier horse 74. They were also reported with relatively rare signs such as *clamping the nose, staring into space* and *heavy eyelids* and the highest severity score on average. Horses in cluster 5 scored very highly for *vertical headshaking, flipping the nose* and *rubbing the nose*, in addition to other signs. A typical horse was perennially affected with seasonal exacerbations and was considered dangerous to ride.

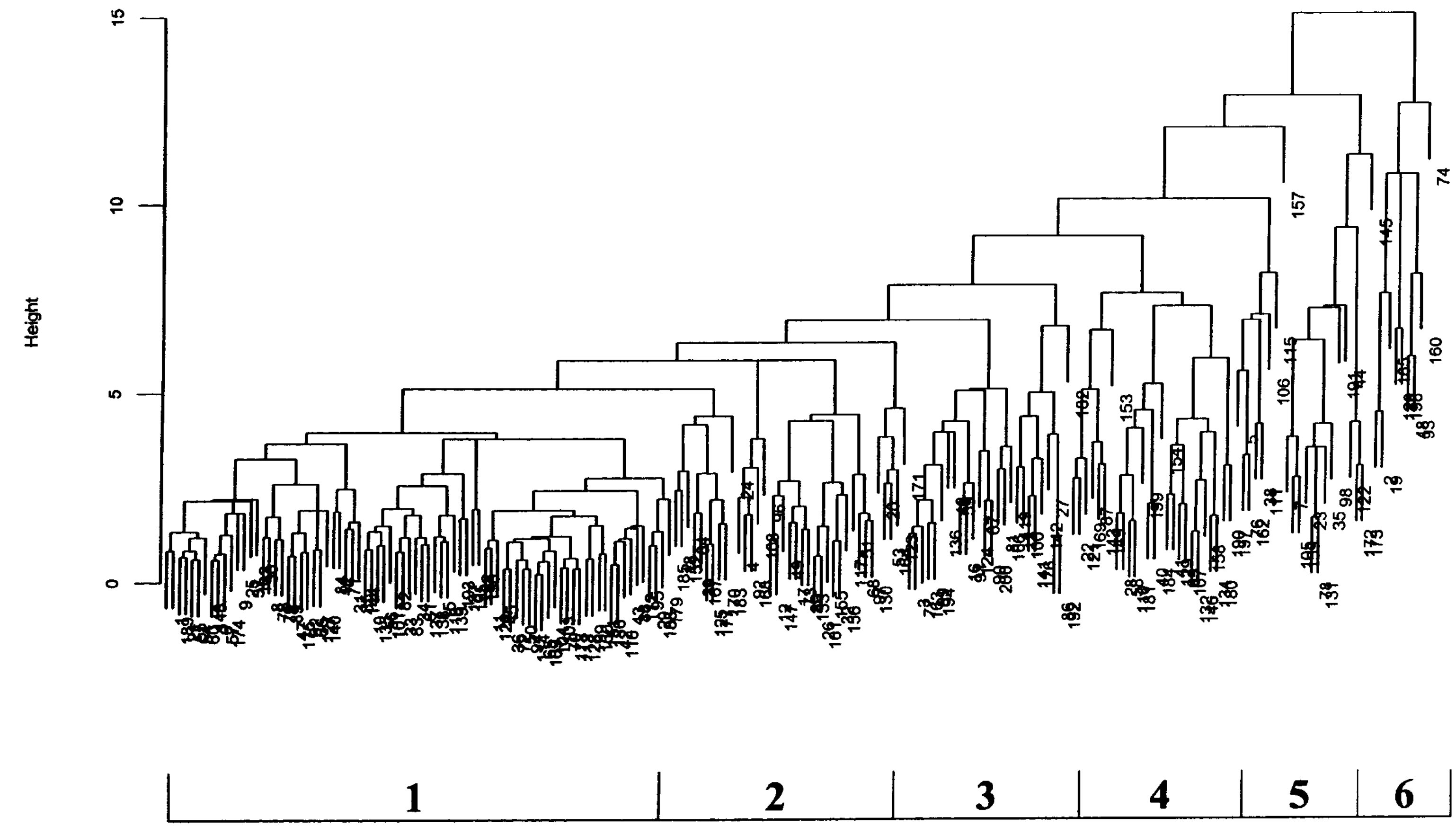

Fig. 5.3 Dendrogram of the clustering of horses based on a divisive hierarchical cluster analysis. Height indicates the diameter of the cluster prior to splitting. 1–6 offers a suggestion for clusters of horses that are relatively similar.

Table 5.7. The median scores for the behavioural signs for each of the 6 clusters created by *k*-means cluster analysis (*N*=number of horses in cluster).

Behavioural sign	1 N=86	2 N=13	3 N=57	4 N=5	5 N=15	6 N=24
Vertical headshaking	1	2	2	4	4	1
Horizontal headshaking	0	0	0	0	0	0
Rotary headshaking	0	0	1	0	1	1
Odd head carriage	0	0	0	0	1	1
Flipping top lip/nose	0	1	1	4	4	0
Snorting	1	3	2	4	3	1
Sneezing	1	3	1	4	2	0
Rubbing nose on objects	1	3	2	4	4	1
Rubbing nose on foreleg	1	3	2	4	4	1
Dropping nose to ground	0	2	1	1	3	0
Striking at nose	0	2	1	0	2	0
Striking out with foreleg	0	1	1	3	1	1
Clamping nose	0	0	0	4	0	0
Coughing	0	2	0	0	0	0
Odd breathing	0	1	0	0	0	1
Inflammation signs	0	0	0	0	0	0
Sweating	0	1	0	0	0	1
Nasal discharge	0	2	1	0	1	0
Twitching	0	0	0	0	0	1
Watering eyes	0	2	0	0	0	0
Blinking	0	2	0	0	0	0
Heavy eyelids	0	2	0	3	1	0
Staring into space	0	0	0	2	0	0
Stumbling	0	1	0	0	0	1
Rushing	0	1	0	1	0	1
Stopping	0	1	0	1	0	1
Other	0	0	0	0	0	0

Table 5.8 The median seasonality type (SS=sunny seasonal, PS=perennially affected with seasonal exacerbations) and severity score (0–4) for horses in each of the six cluster formed by *k*-means cluster analysis. *N* is given for each measure since not all owners provided responses.

Cluster	**1**	**2**	**3**	**4**	**5**	**6**
N	75	10	54	3	11	23
Seasonality type	SS	PS	SS	SS	PS	SS
N	85	13	56	5	15	24
Severity score	3	3	3	4	4	4

Finally, horses in cluster 6 scored low for a range of signs, including *stumbling*, *rushing* and *stopping*. Their median severity score was 4 (dangerous to ride on average).

5.4.7 Predicting reported response to nose net

5.4.7.1 Using principal component analysis

The median score for all horses for the first component was zero, see Fig. 5.2. 93 horses that had tried a nose net had a score for the first component below the median (less than zero). 83 horses that had tried net had a principal component score greater than the median. Those with a score below the median had a mean nose net success of 1.5 (SD 1.04) on a scale from 0 (no effect) to 3 (complete success). Those with a principal component score above the median had mean nose net success of 1.2 (SD 0.97). There was a non-significant tendency for horses that scored lower in the first principal component, i.e. lower for the most common signs of headshaking; *vertical headshaking*, *snorting*, *sneezing*, *rubbing the nose on the foreleg*, *rubbing the nose on objects*, *striking out*, *nasal discharge*, etc. to be reported to respond more favourably to a nose net, (2-sample t-test; $t = 1.95$, $DF = 153$, $p = 0.053$).

5.4.7.2 Using *k*-means cluster analysis

Horses in cluster 1 were reported with the most favourable score for a nose net and horses in group 4 the least, see Table 5. 9. However, there was no evidence of an effect of cluster group on reported response to a nose net (Kruskal-Wallis; H=6.61, DF=5, p=0.251). A comparison of the median score for the effect of a nose net between horses in cluster 1 and all the other clusters suggested that there was a non-significant trend for horses in group 1 to respond more favourably (2-sample t–test; t = 1.70, DF = 137, p = 0.092).

Table 5.9. The average scores for the reported response to a nose net for horses in the six clusters defined by *k*-means cluster analysis, *N* = 176 (not all owners had tried a nose net).

Cluster group	*N*	Median nose net score (0–3)	Mean	SD
1	67	2	1.5	1.02
2	13	1	1.2	0.90
3	54	1	1.3	0.99
4	5	0	0.4	0.55
5	14	1	1.1	0.95
6	23	1	1.4	1.15

5.4.7.3 Using ordinal logistic regression

A logistic regression model failed to find any significant effect of the factors included on the reported response to a nose net, see Table 5.10.

Table 5.10. Ordinal logistic regression model for reported response to a nose net. *N*=154. Factors are listed in descending odds ratio.

Characteristic	**Odds ratio**	**95% CI**	**Z**	**P**
Striking out	1.45	0.95–2.23	1.72	0.086
Clamping nose	1.28	0.89–1.83	1.35	0.177
Severity	1.27	0.86–1.87	1.20	0.229
Seasonality	1.25	0.80–1.94	0.99	0.324
Dropping nose to ground	1.20	0.86–1.68	1.07	0.286
Vertical headshaking	1.01	0.75–1.37	0.07	0.943
Snorting/sneezing	0.92	0.66–1.29	–0.47	0.640
Rubbing nose	0.87	0.64–1.19	–0.85	0.397
Flipping nose	0.82	0.62–1.07	–1.45	0.147

5.5 Discussion

5.5.1 Presentation of the syndrome

Over 80% of the horses were reported to show *vertical headshaking* (93%), *rubbing the nose on the foreleg* (82%), *rubbing the nose on objects* (81%) and *snorting* (81%). Other commonly reported signs included *sneezing* (61%), *striking out of foreleg* (55%), *dropping nose to the ground* (55%), *nasal discharge* (50%), *flipping of top lip/nose* (48%), *striking of foreleg onto nose* (43%) and *twisting/rotary headshaking* (43%). 'Acting like a bee flew up the nose' is likely to be a common description for the behaviour since 74% of 50 owners that were asked felt their horse could be described in this way. These results suggest that the syndrome is characterised by headshaking, snorting or sneezing and various ways of attempting to rub the nose, with other behavioural components being reported less frequently. Madigan and Bell (2001) and Lane and Mair (1987) also reported that vertical headshaking, nose rubbing and snorting were the most common signs in the horses they surveyed.

A whole range of other signs were included in the questionnaire in an attempt to assess their prevalence, but in most cases these were infrequently reported. For example *clamping the nostrils* and *blinking* were reported in only 17% and 9% of horses respectively. These signs, amongst others, had been mentioned by other researchers as being significant in the syndrome (blinking–Cook 2003, clamping the nostrils–Newton *et al.* 2000). However, given that these signs are harder to identify, especially when riding the horse, low reported prevalence may have been expected. Lack of report does not necessarily imply that the sign is not present in that horse. It is also not possible to establish whether the presence of respiratory problems as indicated by *coughing* and *odd/heavy breathing* (reported in 31% and 25% of the horses respectively) is associated with the headshaking syndrome or reflects an unrelated condition. Lane and Mair (1987) also reported coughing in 27% of cases and suggested that the conditions might be related. A case control study, similar to that described in Chapter 2, regarding the reported prevalence of these specific signs might help establish if this is likely to be the case, although reports of COPD in control and headshaking horses were found to be comparable.

Approximately half of the horses were reported to have a nasal discharge. A similar proportion of horses were also reported with a nasal discharge in the studies by Lane and Mair (1987) and Newton *et al.* (2000). As in their cases, the nature of the discharge was usually either clear (serous) or white (mucoid). Attempts to hide the head were reported in about a third of horses. The manner by which the horses were reported to do so varied, suggesting a number of motivations for this behaviour, not just protection of the eyes from sunlight as had been implied in the question (suggested by the research of Madigan *et al.* 1995). Some of the horses may have been attempting to hide the nose and face from the wind or windblown particles (as suggested by Newton *et al.* 2000), and some may have been attempting to relieve the irritation in the nasal/facial area by either pressing the head or nose against a wall (also reported in Newton *et al.* 2000) or by placing the nose in bushes or in water. In addition, nearly half the owners felt their horse had a hypersensitive head area, which was not necessarily concentrated in the muzzle; the head, face, poll and ear areas also being mentioned. Light, tactile sensation seemed to be the most irritating, whether this came from the presence of tack, objects in the air or brushing by the owner. However very few specifically felt that their horse was difficult to bridle in general, which is contrary to the speculation of Cook (2003).

An ethogram was developed based on the reported prevalence of the signs listed in the questionnaire and on video observation of many headshakers. This can form a basis for description of the syndrome for use by other researchers studying the syndrome. It is worth making two observations from the ethogram. Firstly, *dropping the nose to the ground* was described as opposed to rubbing the nose on the ground, since it was observed that horses did not always make contact with the ground when they did so. Perhaps simply lowering the head helps to ease the irritation, by allowing fluids to run down the nasal passage. Secondly, some signs appear to be progressions of others. For example, *striking out* and *striking of the foreleg onto the nose* might represent a more severe form of *rubbing the nose on the foreleg,* which occurs when the horse is moving at a fast pace. Similarly, rotary headshaking may be a progression of vertical headshaking, observed when the horse is particularly irritated.

As expected, the majority of signs were seen most often when the horse was being ridden. For most signs there was a clear increase in the number of horses showing the sign as the level of activity increased from 'when stabled' to 'grazing' to 'when being ridden', with a decrease down to resting levels 'after being ridden'. For example, 22% of horses were reported with vertical headshaking when stabled, 42% when grazing, 97% when being ridden and 29% after being ridden. This suggests that many of the signs are not exclusively observed when the horse is exercised; more that exercise increases the likelihood of them being observed. However, given this pattern, there was a higher than expected percentage of horses showing *coughing* 'when stabled'. This might suggest that a proportion of these horses have a respiratory problem associated with stabling that may or may not be connected to the headshaking problem. In addition, asking owners to specify the situations in which each of the signs occurred may have increased the tendency for signs to be reported that do not necessarily form part of the headshaking syndrome and/or present a problem to the owner. For example, *heavy eyelids/dopey expression* and *staring into space* were often reported in horses 'when stabled' and it is possible that many of these cases constitute 'normal' resting behaviour.

5.5.2 The validity of owner reports

The fact that no horses had to be rejected from the survey based on a lack of head shaking or twitching behaviour at exercise (see Section 3.3.2), suggests that owners are aware of the meaning of 'headshaking problem' and are not confusing it with 'nodding' (see Cooper *et al.* 2000). In addition, the similarity in the reported prevalence of the main signs of the headshaking problem between this and other studies (see Chapter 4) suggests that they are all reporting the same phenomenon. Finally, there were no significant differences in the reported prevalence of the main signs of headshaking; *vertical headshaking*, *rubbing the nose on the foreleg* and *snorting*, between horses that had been reportedly treated by a veterinary surgeon for the headshaking problem and those whose owners did not report any consultation with a veterinary surgeon. It was assumed that horses whose owners had consulted a veterinary surgeon regarding the headshaking problem were more likely to be what the veterinary community would consider to be headshakers. That there is little difference in the prevalence of signs between these and horses that have not been taken to a veterinary surgeon suggests that two populations are similar. However, reporting of signs was consistently higher by owners of horses that had been treated by a veterinary surgeon, in particular; *dropping the nose to the ground*, *clamping the nostrils*, *striking out with the foreleg* and *rubbing the nose on objects*. This may suggest that the presence of signs encourages consultation with a veterinary surgeon. Since the number of signs was found to correlate to some extent with the reported severity of the condition these horses may also be more severely affected. Also, the owners may be more vigilant of the signs associated with the syndrome following consultation with the veterinary surgeon.

5.5.3 Differences in symptomatology between seasonal forms of headshaking

There were no significant differences in the reported prevalence of most of the signs including the most common headshaking signs, between horses that were reported to be sunny seasonally–, perennial– (but with seasonal exacerbations) and perennially–affected. There were significant differences between the three seasonality types with regard to *flipping the nose* ($p = 0.010$), *clamping the nostrils* ($p = 0.012$), *dropping the nose to the ground* ($p = 0.028$) and *striking at the nose* ($p = 0.042$). For the latter three there was an increase in reports as the seasonal pattern to the headshaking became less apparent. For *flipping the nose,* horses that were perennially affected with seasonal exacerbations were most likely to be reported with this sign. It might have been supposed that these signs are more indicative of allergic nasal irritation and therefore more apparent in the seasonally headshaking horses. Their higher reported prevalence in horses that are affected all year round might indicate a greater severity of the problem in these horses or a particular irritation in the end of the muzzle area. Given that perennial horses were more likely to be rated as more severely affected, the former suggestion cannot be ruled out. A tendency for non-seasonally headshaking horses to *cough* and *stumble* might also indicate a greater severity to their problem or associated problems. Perennially affected horses were also more likely to headshake *in the rain*, *when excited* and *when nervous*. If they have a particular irritation in the end of their muzzle then it is possible that rain drops trigger this. Increased likelihood of headshaking when aroused is not unexpected in the non-seasonally affected horses since they might be more severely affected and have a lower threshold for tolerating the irritation. Also, because the owner cannot attribute any change in their behaviour to the seasons they may be trying to attribute it to their emotional state.

Mills *et al.* (2002a) performed a similar analysis comparing seasonally and non-seasonally affected horses. Surprisingly, given inclusion of many of the same horses, some of their findings were not supported in this study. In particular, in this survey, there was no evidence to suggest that sunny seasonally affected horses are more likely to be reported to headshake on *bright, sunny days*, be geldings or *flip their nose*. This suggests that classifying the horses into seasonal types based on the occurrence of their headshaking over the previous year yields different results to classification based on an open-ended question. However, the similar finding in the two studies that non-seasonal headshakers were more likely to shake *when excited* and *in the rain* suggests that this association is more robust.

5.5.4 Classification of headshakers

Seven principal components were found to explain 55% of the variation in symptomatology of 200 horses. Explanation of the constitution of only the first two components was attempted, however, since subsequent components explained a small proportion of the variation in the horses. The first component appeared to describe the general headshaking syndrome and loaded heavily on the most commonly reported signs such as *vertical headshaking*, *snorting* and various attempts to rub the nose. The second component appeared to differentiate between horses that had a nasal component to their problem and horses with a behavioural component to their behaviour, possibly similar to stereotypy. However, a bi-plot of the location of the horses in two-dimensional space, based on their score for the first two components, suggested that there was little to differentiate between the horses.

Similarly, cluster analysis of the horses based on the first seven principal components failed to identify clear, natural groupings of horses. A description of six clusters of horses based on a *k*-means cluster analysis was offered. The majority of horses presented in a similar manner; being reported with the main signs of headshaking but to varying degrees of severity (cluster 1 and cluster 3). Some horses fell into clusters that were also reported with all the main signs of headshaking but with additional signs. These may represent owners with a tendency to over-report or horses with problems additional to headshaking. These two analyses suggest that the majority of the horses present similarly, with differentiation possible only on reports of additional signs. In fact, 78% of horses in the survey were reported to shake their heads, rub their noses on objects or the foreleg and snort or sneeze. This suggests that these are the main signs of the syndrome. The presence of other signs may be indicative of severity, different ways in which the horse rubs its nose and/or additional conditions to the headshaking problem.

5.5.5 Predicting response to a nose net

A variety of multivariate techniques were used to attempt to describe the relationship between reported response to a nose net and symptomatology. Based on a principal component analysis, there was a tendency for those horses with low scores for the main signs of headshaking to score higher for response to a nose net. This finding was mirrored in the results from a cluster analysis, in that horses with low scores for the main signs of headshaking (cluster 1) tended to be reported to have more success with the nose net. This association makes sense since low scores for the main signs might indicate a milder form of the problem. However a logistic regression model failed to find any significant factors indicative of success with the nose net, including the horse's severity score and seasonality type. This gives rise to a number of conjectures. Firstly, the nose net might have a general effect on the headshaking and as such no differentiation between types of headshaker will be possible by looking at success of the nose net. The suggestion that the nose net has a competitive or distracting effect on the headshaking (Mills *et al.* 2002b) might support this. Secondly, symptomatology did not inform on success of the nose net because the horses were presenting similarly. This is supported by the lack of clear differentiation of headshakers based on principal component and cluster analysis. Thirdly, the use of many possible explanatory variables (signs) and a relatively small number of horses resulted in models that were unstable and subject to change depending on the selection of horses for inclusion in the model. Thus, the study is probably better referred to as being 'uninformative' due to inadequate statistical power (Harrell *et al.* 1985) as opposed to being indicative of a lack of differentiation between headshakers.

5.5.6 Summary

The horses included in the survey presented with similar signs to those from other studies of headshakers including those from referral case studies. This suggests that a similar 'headshaking phenomenon' is being assessed in these studies, regardless of the source of the information and presentation to a veterinary surgeon. Inclusion of a larger range of signs than in previous studies, however, failed to identify any other signs than those already familiar to the syndrome. Differentiation of the horses based on this range of signs was also unremarkable, suggesting that the majority of horses presented similarly. In addition, presentation of the syndrome had little bearing on the reported response to a nose net, although there was some evidence to suggest that horses that benefited most were those that represented a typical, mild headshaker with a seasonal component to the problem. It is suggested that future work might focus on establishing efficacy of other treatments that are likely to be more selective in their mode of action. In this way, differential response to treatment might have more diagnostic meaning. The study described here used owners as reporters of their horse's behavioural signs. The extent to which owners are consistent at reporting these signs, and therefore the extent to which their reports are reliable, will be the subject of the next three chapters.

Chapter 6

Part III

The consistency of owner reports:

1. Inter and intra-owner agreement regarding the presence of headshaking signs on a videotape

6.1 Introduction

Much of the information about headshaking syndrome has come from case studies conducted by veterinary surgeons (e.g. Lane and Mair 1987, Mair *et al.* 1992, Mair 1994, Madigan *et al.* 1995, Newton *et al.* 2000). In these studies, each horse would have been evaluated by the surgeon and idiopathic headshaking diagnosed when other conditions had been ruled out. However, the number of horses included in each study was small, which reduces the potential to make confident generalisations regarding the condition. Lane and Mair (1987) were only able to report on a large number of horses by collating case reports from their veterinary hospital over a 10-year period. In order to obtain similar sample sizes over a shorter period of time, some researchers have used the reports from owners in a self-selected survey, for example, Mills *et al.* (2002, a, b) and Madigan and Bell (2001). The survey of 200 horses described in previous chapters (Q2000) also relied on owner report.

There are many advantages to the use of owners as reporters of their animal's behaviour, including the ability to recruit large numbers of subjects, at little cost, over a short period of time. However, there are also legitimate concerns that need to be addressed regarding the reliability and validity of their reports. Behavioural measures need to be 'valid' in that the outcomes are measuring what is intended (Martin and Bateson 1993). For example, are owners presenting horses suffering from the same headshaking phenomenon as those in the veterinary case reports? The validity of owner reports was addressed to some extent in Chapters 2 and 5. In Chapter 2, no evidence was found to support the suggestion that owners were reporting headshaking behaviour in 'normal' horses. In chapter 5, no evidence was found to support the suggestion that horses that had been treated by a veterinary surgeon for headshaking had a different reported presentation of the main signs to those that had not received any attention. The validity of the reports of owners will also be covered in Chapter 8.

Measurements also need to be 'reliable' in that the outcomes are measured consistently not only by the same person (intra-observer agreement) but by different people on different occasions (inter-observer agreement) (Martin and Bateson 1993). It is important to assess the reliability of the observations and assessments since a lack of intra- or inter-observer consistency will introduce errors that might obscure (or falsely create) differences between measures. Owners are a potentially useful source of information regarding their horse's behaviour but, it is important to attempt to properly assess the consistency of their reports. However, in order to properly evaluate the consistency of reports within and between observers (owners) it is important that both the behaviour being observed on the two occasions and the methods used to observe and rate the behaviour are the same (Martin and Bateson 1993).

An effective method for assessing the consistency of owner reports is through the observation of video recordings. In this way it is possible to evaluate the agreement amongst several owners who view the same piece of behaviour (inter-owner agreement), as well as within the same owner through their repeated viewing of the same video clip (intra-owner agreement). The use of video clips of behaviour to assess the consistency of observers' reports is well established (Martin and Bateson 1993). It has been used, for example, to assess the agreement between veterinary surgeons in scoring lameness (Fuller *et al.* 2000) and between researchers observing aspects of horse behaviour (McDonnell and Diehl 1990). It is a good alternative when observation of the behaviours by several assessors at the same time is not possible and it also helps to standardise other variables such as the length of time for which a behaviour is observed by the assessors, etc. In addition, given the variation in presentation of the syndrome, analysis using video clips enables the consistency of reports to be assessed for many owners regarding the presence of a range of signs from a range of horses, which would not be possible otherwise.

6.2 Aims

1. To test the null hypothesis that there is no difference in the reports within owners assessing the same piece of headshaking behaviour on two separate occasions (intra-owner agreement).
2. To test the null hypothesis that there is no difference in the reports amongst owners assessing the same piece of behaviour (inter-owner agreement).
3. To evaluate the intra- and inter-owner agreement of the decision to label a horse as acting like a headshaker, and to establish which signs appear to be associated with this decision.

6.3 Method

6.3.1 Recording a videotape of headshaking horses

As part of the survey described in Chapter 3, owners were encouraged to submit video footage of their horse headshaking. In total, 34 videotapes were received and a selection of these was chosen to create a videotape for the purposes of assessing the consistency of owner reports. The only selection criterion applied to the video footage was the clarity of each clip. Two videotapes were created, each holding 12 clips of different horses (horse clips) lasting approximately one minute each. Six of the horse clips on the first videotape were included in the second videotape. As a result, a total of 18 horse clips featured on the two videotapes, 6 of these featuring on both videotapes.

Of the 18 horse clips included on the videotapes, 16 of the horses were believed to be headshakers by their owners and had been included in the NEHS database. The remaining two clips were of a horse that raised its head repeatedly when walking (horse 7) and a riding school horse that tossed its head when made to stand (horse 14). One of each of these 'non-headshaker' horse clips was included on each tape as a control. The order of presentation of the clips on the videotape was the same for every owner and was chosen without any design. The clips that featured on both videotapes were presented in the same order each time to control for any temporal effects. Table 6.1 lists the order of presentation of horse clips in both tapes.

Table 6.1 The order of presentation of the horse clip (nos. 1–18) for videotapes 1 and 2, shaded horse numbers featured on both videotapes in the same sequence.

Clip sequence		1	2	3	4	5	6	7	8	9	10	11	12
Horse No	Videotape 1	1	2	3	4	5	6	7	8	9	10	11	12
	Videotape 2	13	14	3	4	15	6	16	17	9	10	18	12

6.3.2 Choice of signs to be assessed

The signs to be recorded by the owners in the videotape assessment were determined from those reported in over 30% of horses in the survey described in Chapter 5 (see Table 5.1). *Nasal discharge* and *coughing* were omitted from the list as they could not be observed with any certainty from the video clips chosen. *Rushing forward* and *stumbling* were also excluded as they were considered to represent particularly subjective terms of less clinical significance. *Sneezing* and *snorting* were combined into a single category *snorting/sneezing* since distinguishing between the two was not considered to be important. For the same reason only *striking out with the foreleg* was included and not *striking of the foreleg onto the nose.* The signs chosen for assessment and their reported prevalence in the Q2000 survey are listed in Table 6.2.

Table 6.2. Behavioural signs used in the videotape assessment and their reported prevalence in the Q2000 survey (*N*=200, see Table 5.1).

	Behavioural sign	**Reported prevalence (%)**
1	***Vertical headshaking***	93
2	***Rubbing nose on foreleg***	82
3	***Rubbing nose on objects***	81
4	***Snorting/sneezing***	81
5	***Striking out of foreleg***	55
6	***Dropping nose to the ground***	55
7	***Flipping of top lip/nose***	48
8	***Twisting/rotary headshaking***	43
9	***Horizontal headshaking***	31

In addition, the owners were asked to decide for each horse clip if the horse had:

- 'Acted as if a bee had flown up its nose?'
- 'Acted like a headshaker?' (in their understanding of the word)

An additional sign, '*any headshaking*' was defined *post hoc* and awarded to each horse clip if the assessor had reported any of the following; *vertical, horizontal* or *rotary headshaking.*

6.3.3 Recruitment of owner assessors and instructions for the assessment

24 horse owners who had participated in at least one of the field trials run by the National Equine Headshaking Survey (e.g. Mills and Taylor 2003) were approached and agreed to take part in the videotape assessment. A list of their horses and the trials in which they participated is shown in Appendix VI. A copy of videotape 1 was first sent to each owner in the post together with a form for the completion of the assessment, written instructions for how to observe and record their observations from the videotape and a pre-paid envelope for the return of the form. The instructions and assessment form are presented in Appendix VII. The owners were instructed to watch the videotape through first before attempting to record the presence of any headshaking signs, in order to minimise the effect of increased familiarity with the signs over time. They were then asked to watch the tape again, pausing after each horse clip in order to complete the assessment form for that horse. The form asked the owner to tick each of the 9 headshaking signs they believed that they had observed and to decide whether they felt the horse had also acted like 'a bee flew up its nose' and 'acted like a headshaker' (as they understood it). They were then asked to return the completed form using the pre-paid envelope. One week following the return of the assessment form, the owners were sent videotape 2 to view (resulting in the tapes being watched approximately 2 weeks apart) and an identical form to complete regarding the assessment of the videotape.

6.3.4 Analysis of results

<u>6.3.4.1 Intra-owner agreement</u>

24 owners assessed the presence of 9 headshaking signs and made 2 decisions regarding 6 horse clips which were repeated on both videotapes. This allowed a comparison to be made of their report for each horse clip from the first viewing (videotape 1) to the second (videotape 2). For each of the headshaking signs and decisions there were two possible responses; sign present (yes, ticked) or sign absent (no, left blank). The

combinations of responses for each of the 6 horse clips between the two videotapes were recorded. Possible combinations of agreements for each sign for each horse clip were that the owner responded 'yes' in videotape 1 and 'yes' in videotape 2 (YY), or 'no' in videotape 1 and 'no' in videotape 2 (NN). Possible disagreements between the two videotapes were 'yes' in videotape 1 and 'no' in videotape 2 (YN), or 'no' in videotape 1 and 'yes' in videotape 2 (NY). The total number of each response combination for 6 horse clips assessed by 24 owners (i.e. out of 144) was presented. McNemar's test (Q_M) was used to test the association between videotape (1 or 2) and presence of each headshaking sign (yes or no). This test looks at the differences between counts of discordant pairs relative to the number of concordant pairs, see Section 2.3.2. Exact p-values were calculated where applicable. A p-value <0.05 was taken to suggest that there was a greater tendency for owners in one videotape to report the presence of a sign than in the other

The percentage of owners that reported similarly in both videotapes (i.e. YY or NN) was calculated as an average across the 6 horse clips (i.e. number of agreements divided by 24 owners and 6 horse clips, i.e. out of 144) and given as a measure of the *average* extent of the agreement. It was decided *a priori* to conservatively define agreement as 'good' if there was 80% agreement or higher, 'moderate' if agreement was between 60-79% and 'poor' if agreement was less than 60%. The percentage agreement was not presented for signs with a reported prevalence of less than 30% in both videotape 1 and 2 since there would be insufficient reports to reliably determine agreement (see below).

Cohen's kappa coefficient of agreement is frequently used to assess the level of agreement in situations such as this (Cohen 1960). It provides a measure of the agreement between one or more observers taking into account the amount of agreement that could have occurred purely by chance alone. It is calculated thus:

$$Kappa = \mathrm{P(O)} - \mathrm{P(C)} / 1 - \mathrm{P(C)}$$

where P(O) is the proportion of occasions that *k* (number of) observers agree and P(C) is the proportion of occasions that the observers would be expected to agree by chance.

However, kappa was not used in this instance since it can be heavily influenced by the extent of bias and prevalence in the sample (Byrt *et al.* 1993). A difference between the two observers in their tendency to record the occurrence of a sign is known as bias (and can be detected by McNemar's test). As bias increases, P(C) decreases and so kappa increases. If the extent of bias differs between behavioural signs, for example, then kappa values will not be directly comparable. The value of kappa is also affected by the relative probability of the responses 'yes' and 'no', i.e. prevalence. For example, if the prevalence of a sign is particularly high or low then the proportion of times that the observers would be expected to agree, P(C), is also high. Just one or two disagreements can therefore produce extremely low values of kappa that arguably do not accurately reflect the amount of agreement. For example, if the prevalence of *vertical headshaking* is 100% amongst the 6 horse clips in videotape 1 and 99% amongst the same clips in videotape 2 (i.e. there is one disagreement), kappa is zero, suggesting that there is no agreement at all between observers since they were all expected to agree by chance anyway.

There are alternatives to kappa, such as bias and prevalence adjusted kappa (PABAK) (Byrt *et al.* 1993) and relative improvement over chance (RIOC) (Copas and Loeber 1990), but these adjustments do not solve this issue completely, do not cover agreement between multiple observers and so are not widely used in the literature. Similarly, choosing an arbitrary value for the proportion of agreement expected by chance such as 50%, given two response categories, would not have been satisfactory since the probability of the owners reporting the presence of the sign depends on the likelihood that the horse actually showed the sign. Thus the reported prevalence of each sign is inextricably linked to the likelihood of agreement. For example, average agreement between 90% of owners that the sign was present (agreed–present) represents high agreement, but average agreement between 90% of owners that the sign was *not* present (agreed–absent) does not necessarily constitute the same, high agreement. In the latter situation, it is likely that the sign was not present in many of the examples used and therefore there is less information available to assess the agreement. In both these situations kappa would be a low value whereas it should arguably be high for agreed–present and not given for agreed–absent.

It was decided to present the percentage agreement alone as the measure of agreement, together with a discussion of the impact of bias and prevalence on this figure, as suggested by Byrt *et al.* (1993). Signs with a particularly low prevalence (less than 30%) were not analysed since the percentage agreement would be less likely to reflect the true agreement level. However, signs with a high prevalence (i.e greater than 70%) were still analysed, not only because they are arguably more important, but because it was felt that, since in these cases the observers made a conscious decision to report the sign, the percentage agreement is more likely to be a true reflection of agreement than for rarely observed signs, where non-report does not necessarily mean that the observer considered the sign was not present.

6.3.4.2 Inter–owner agreement

24 owners assessed the presence of 9 headshaking signs and made 2 decisions regarding a total of 18 horse clips over the two videotapes. This information was used to assess the extent of the agreement between the owners with respect to identifying the presence of each of these headshaking signs across the 18 clips. Firstly, the average prevalence of each sign across the 18 horse clips as reported by the 24 owners was determined. This was calculated as the total number of positive reports for each sign divided by 432 (24 owners assessing 18 horse clips).

The mean agreement amongst the owners for each of the nine signs was measured using the equation given by Fleiss (1971) for measuring nominal scale agreement among many raters. The observed agreement for each horse clip was determined by:

$$\text{Proportion agreement for each horse clip} = \frac{1}{n(n-1)} \sum_{j=1}^{k} n_{ij}(n_{ij}-1)$$

Where, n=number of ratings per subject (i.e. 24), i=1,... N, represents each subject (i.e. horse clip) and j=1,...k, represents the categories of the scale (i.e. yes and no). n_{ij} is therefore the number of owners indicating the presence (or absence) of the sign for each horse clip.

The mean agreement for each sign was calculated as the sum of the proportion agreement for each horse clip (defined above) divided by the total number of horse clips, i.e. 18. For the same reasons as discussed above, kappa (in this case Fleiss' generalisation of kappa for several raters (Fleiss 1971)) was not used to present the chance-corrected agreement amongst the owners. Instead, the observed mean agreement alone, as defined above, was presented together with the mean prevalence of the sign.

A plot of the number of positive reports for each sign and each horse clip was produced as another method of representing the prevalence and inter-owner agreement for each sign. For each horse, and for each sign, a score from 0 to 24 was given according to how many owners had reported the presence of the sign. A score of 0 indicated that none of the owners considered that they had observed the sign in that horse and a score of 24 indicated that all owners had reported the presence of that sign. The plot was divided into the three 'agreement areas', with each horse clip lying in one of these areas. It was decided *a priori* that for each horse and sign, a score in the range of 0 to 7 would indicate that, in general, owners considered that the horse had not shown the sign (agreed–absent). A score of 17 or more would indicate that overall the owners agreed that the horse had shown the sign (agreed–present). Scores in the range 8–16 therefore represented a certain amount of disagreement between the owners (less than 70% agreement) for that horse and that sign (disagreement).

8.3.4.3 Which signs are associated with the decision to rate the horse as a headshaker?

A generalised linear model (PROC GENMOD, SAS v 8.0, SAS Institute, Inc) was fitted to the binary outcome of whether the horse 'acted like a headshaker' and the presence of the nine signs including whether the horse 'acted like bee flew up the nose'. The outcomes of all horse clips from all the owners were included in the model and the REPEATED statement was used with 'horse' as the repeated subject since the owners all viewed the same 18 horses. To allow for correlations between the repeated assessments of the same horse, the method of generalised estimating equations was used (Liang and Zeger 1986).

6.4 Results

6.4.1 Intra-owner agreement

Snorting/sneezing and *vertical headshaking* were the most prevalent signs amongst the 6 horse clips, see Table 6.3. *Striking out of the foreleg, horizontal headshaking, rubbing the nose on the foreleg* and *rubbing the nose on objects* were reported in less than 30% of horse clips on both occasions. *Striking out of the foreleg* was only reported by one owner on the second videotape. The majority of owners considered that the six horses 'acted like a headshaker' in their understanding of the word (76% in videotape1 and 83% in videotape 2).

The extent of disagreement in the 6 video clips did not differ significantly between the two viewings with the exception of *rotary headshaking* (Q_M = 12.50, p<0.001) and whether the horse 'acted like a headshaker' (Q_M = 4.17, p = 0.041). In both cases the owners tended to be more likely to report these in the second viewing, see Table 6.3.

There was good agreement (greater than 80%) on average within the owners for all the signs with the exception of *rotary headshaking* (78% agreement), see Table 6.3. *Striking out of the foreleg, horizontal headshaking, rubbing the nose on objects* and *rubbing the nose on the foreleg* were not evaluated as they had a reported prevalence of less than 30% in both videotapes.

Table 6.3. **The average % agreement within owners of the presence (Y) or absence (N) of headshaking signs in the first videotape (1) and the second (2) (24 owners, assessing 6 horses, N=144). Signs are listed in descending order of agreement. Shaded cells indicate significant disagreements between the videotapes (McNemar's test, Q_M and p-value are given in the text).**

Behavioural sign	1 (Y) 2 (Y)	1 (Y) 2 (N)	1 (N) 2 (Y)	1 (N) 2 (N)	Mean agreement (%)
Dropping nose to the ground	45	5	6	88	92
Any form of headshaking	116	5	11	12	89
Snorting/sneezing	120	7	12	5	87
Flipping the top lip/nose	43	8	13	80	85
Vertical headshaking	90	10	13	31	84
Acting like bee flew up the nose	29	11	17	87	81
Act like a headshaker	100	9	20	15	80
Rotary headshaking	47	6	26	65	78

Signs not evaluated as they had a reported prevalence of less than 30% in both instances were: *striking out of foreleg, horizontal headshaking, rubbing the nose on objects* and *rubbing the nose on the foreleg.*

6.4.2. Inter-owner agreement

There was good agreement between owners (above 80%) for the presence of 'any form of headshaking', *snorting/ sneezing* and *dropping the nose to the ground*, see Table 6.4. There was moderate agreement (above 60%) for *vertical headshaking*, 'acting like a headshaker' and *flipping the nose*. However, for 'acting like a bee flew up the nose', *rotary headshaking*, *rubbing the nose on the foreleg*, *rubbing the nose on objects*, *striking out with the foreleg* and *horizontal headshaking* the mean reported prevalence was less than 30%, providing less information with which to test agreement.

Table 6.4. The mean reported prevalence (%) of the behavioural signs listed and the mean agreement (%) between 24 owners as to the presence of these signs in 18 horses, listed in descending order of mean reported prevalence. Double line separates signs with 30% reported prevalence.

Behavioural sign	Mean prevalence (%)	Mean agreement (%)
Any form of headshaking	75	81
Vertical headshaking	68	77
Acting like a headshaker	62	69
Snorting/sneezing	62	86
Dropping nose to ground	36	87
Flipping nose	30	76
Acting like a bee flew up the nose	23	71
Rotary headshaking	22	75
Rubbing nose on foreleg	14	95
Rubbing nose on objects	14	84
Striking out of foreleg	11	90
Horizontal headshaking	11	83

Figure 6.1 provides the distribution of the positive reports of scores for each sign out of 24 for horse clips 1 to 18. Each horse clip is represented by a circle within each vertical strip for each sign. Those horses lying in the lower third of the y-axis range were considered by the majority of the owners to not present with the sign in question (agreed–absent). Horse clips in the top third of the plot were considered by most owners to have presented with the relevant sign (agreed–present). The presence or absence of the sign in question was most in doubt for those horse clips lying in the centre third of the plot, representing a score of between 8 and 16 out of 24 (disagreement).

Agreement for a sign can be shown by the extent of the spread of the scores in Figure 8.1. Signs for which there was considerable agreement would have scores towards the extremes of the scale indicating that most owners agreed that the signs were present in some horses and not others. A lack of horse clips in the central 'disagreement' zone would also indicate a degree of consistency to the owner's reports. None of the horse clips fell into the 'disagreement' range for *rubbing the nose on the foreleg* and *dropping the nose to the ground* and only one horse clip fell into the disagreement range for *horizontal headshaking, snorting/sneezing* and *flipping the top lip/nose.* Conversely, there was considerable spread to the distribution of the scores for each horse clip for whether the horse was considered to 'act like a headshaker', 'act like a bee flew up the nose', presence of *vertical headshaking, rotary headshaking* (and any form of headshaking).

The observed agreement between owners appeared to be particularly high for some signs that were rarely reported. For example, for none of the horse clips was *horizontal headshaking* reported to have been 'agreed–present' (no horse clip above a score of 16) and for only one horse clip each was there 'agreed–present' for *rotary headshaking, rubbing the nose on objects, striking out with the foreleg* and *acting like a bee flew up the nose.*

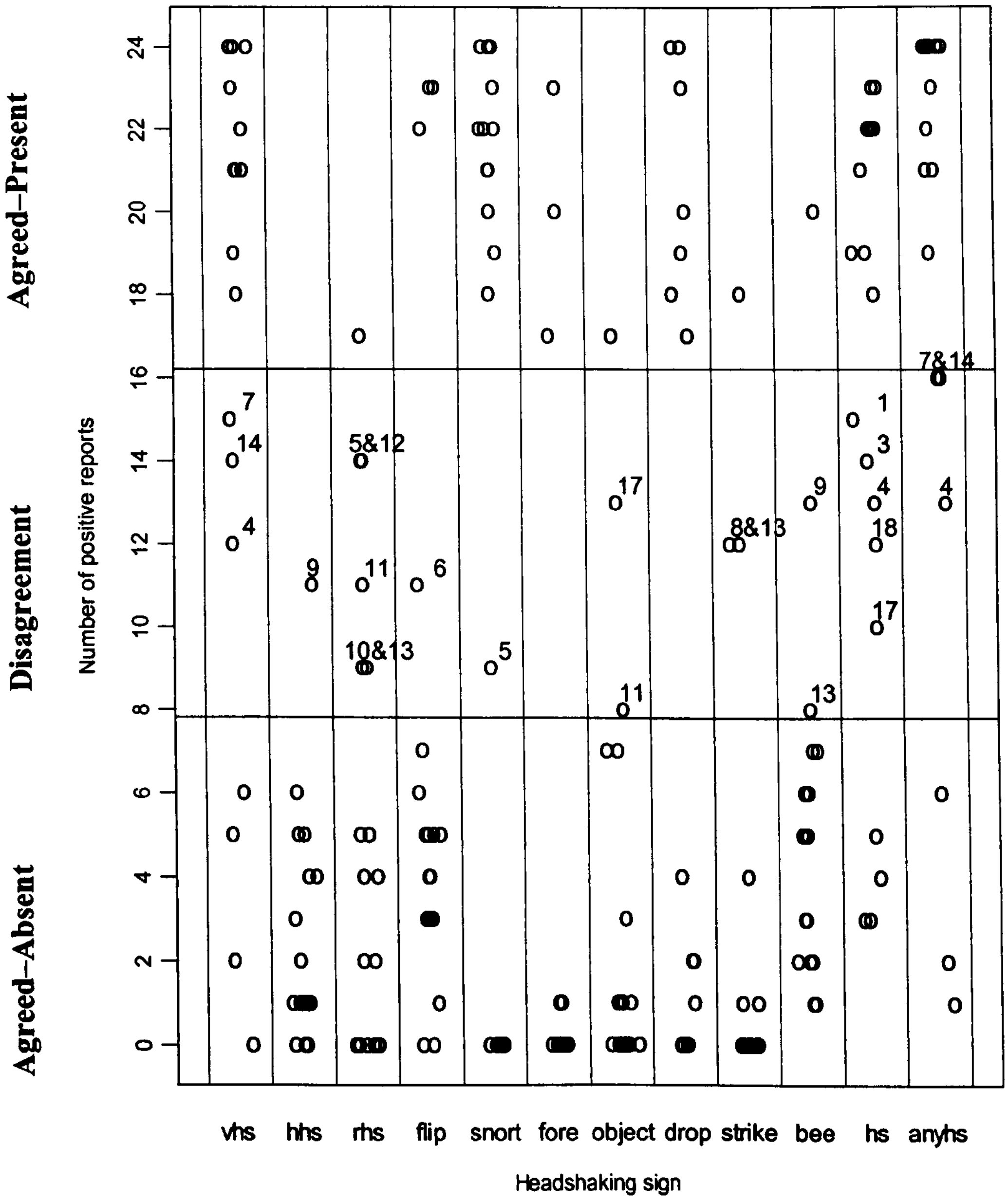

Fig. 6.1 The number of positive reports (0–24) in 18 horse clips for each of 12 headshaking measures. Horse clips are represented by the circles (18 for each headshaking sign) and have been jittered horizontally for clarity. Horses for which there was particular disagreement between the owners (8-16 reports) with respect to the presence of the sign in question are shown by their number.

[**vhs**–*vertical headshaking*, **hhs**–*horizontal headshaking*, **rhs**–*rotary headshaking*, **flip**–*flipping the top lip/nose*, **snort**–*snorting or sneezing*, **fore**–*rubbing the nose on the foreleg*, **obj**–*rubbing the nose on objects*, **drop**–*dropping the nose to the ground*, **strike**–*striking out of foreleg*, **bee**–'acting like a bee flew up the nose', **hs**–'horse acts like a headshaker', **any**–*any form of headshaking* reported].

Owners were in some agreement as to the lack of 'acting like a headshaker' behaviour for horses 7, 8, 14 and 16. Horses 7 and 14 were not on the NEHS database and were not considered by the author to be headshakers either, although, horses 8 and 16 were. The majority of the owners did not report these latter two horses as showing 'any form of headshaking', *snorting/sneezing* or 'acting like a bee flew up the nose', which might explain their tendency to not report them subsequently as acting like a 'headshaker'. The decisions regarding these four horses were not unanimous however; with between 3 and 5 owners reporting that they felt the horse 'acted like a headshaker'. There was also considerable disagreement regarding five other horses.

6.4.3 Which signs are associated with the decision to rate the horse as a headshaker?

How the presence of a sign was associated with the decision to classify the horse as a 'headshaker' was established by fitting a generalised linear model with the headshaker status as the outcome. The 9 headshaking signs, including whether the horse 'acted like a bee flew up the nose', were included as factors in the model. The sign that was most predictive of the decision to report that 'the horse acted like a headshaker' was *vertical headshaking* ($Z = 6.73$, $p<0.001$), see Table 6.5. However, all but one of the signs, *striking out of the foreleg*, were also significant factors in the model. Other important predictors of the owner's decision were *snorting/sneezing* ($Z = 4.12$, $p<0.001$) 'acting like a bee flew up the nose' ($Z = 3.89$, $p<0.001$) and *rotary headshaking* ($Z = 3.48$, $p<0.001$). *Dropping the nose to the ground* ($Z = 2.93$, $p = 0.003$) and *rubbing the nose on objects* ($Z = 2.71$, $p = 0.007$) were also important signs. *Horizontal headshaking*, *flipping the nose* and *rubbing the nose on the foreleg* were less influential in the owner's decision.

Table 6.5. Results from a generalised linear model of the influence of 10 headshaking signs on the decision that 'the horse acted like a headshaker'. The parameter estimate, its standard error and 95% confidence limits (C.L.) are given for each sign, together with the approximation to the normal distribution of the parameter estimate, *Z*, and accompanying p-value.

Behavioural sign	Estimate (SE)	95% C.L.	*Z*	P
Vertical headshaking	0.31 (0.05)	0.21–0.40	6.73	<0.001
Snorting/sneezing	0.24 (0.06)	0.12–0.35	4.12	<0.001
Acting like bee flew up the nose	0.17 (0.04)	0.09–0.26	3.89	<0.001
Rotary headshaking	0.15 (0.04)	0.06–0.23	3.48	<0.001
Dropping nose to ground	0.14 (0.05)	0.05–0.24	2.93	0.003
Rubbing nose on objects	0.11 (0.04)	0.03–0.20	2.71	0.007
Horizontal headshaking	0.11 (0.05)	0.02–0.21	2.41	0.016
Rubbing nose on foreleg	0.15 (0.07)	0.01–0.30	2.14	0.032
Flipping nose/top lip	0.08 (0.04)	0.00–0.16	1.97	0.049
Striking out of foreleg	0.09 (0.05)	0.00–0.19	1.91	0.057

6.5 Discussion

The average percentage agreement *within* owners for those signs for which there was sufficient reported prevalence was in the range of 78–92%. There was most agreement for *dropping the nose to the ground* (92%), and for *any form of headshaking* (89%) and *snorting/sneezing* (87%), which were the two signs with the highest reported prevalence.

The average percentage agreement *between* the owners for those signs for which there was sufficient reported prevalence was in the range of 69–87%. The agreement was strongest for *dropping the nose to the ground* (87%), and for *snorting/sneezing* (86%) and *any form of headshaking* (81%). The latter two had the highest reported prevalence.

As was the case for *within* the owners, the agreement *between* the owners was slightly better if the signs of *rotary*, *vertical* and *horizontal headshaking* were combined to a single category ('any form of headshaking'). And, as expected, the agreement between owners was higher for more identifiable signs such as *snorting* and *dropping the nose to the ground* compared to less obvious signs such as *flipping the nose* and types of *headshaking*. Nonetheless, the agreement amongst owners for these signs was also reasonable.

A plot of the number of reports out of 24 that each horse clip received for the presence of each sign helped to illustrate the agreement between the owners (Fig. 6.1). Although the overall average agreement was reasonable for the presence of *vertical headshaking* (77%), the distribution of the number of reports for this sign amongst the horse clips was spread the most widely. Owners tended not to be in strong agreement as to its presence or absence and were in considerable disagreement over some horse clips. Signs for which there was the highest degree of polarisation (owners tending to agree that the sign was either present or absent) were *snorting/sneezing*, *dropping the nose to the ground* and *striking out of the foreleg*. However, for a few rarely reported signs e.g. *horizontal* and *rotary headshaking* and 'acting like a bee flew up the nose' there were some owners that did report the sign, making the agreement as to its absence in some horses was far from unanimous.

No selection was applied when compiling the videotape, other than trying to maximise the clarity of each clip. It was the intention that, in this way, the videotapes would show a range of horses and headshaking behaviours that were representative of the population that had supplied the tapes. However, as a result, the videotapes included horses that either showed few signs or had more subtle problems. In many ways the 'snapshot' of headshaking behaviour created by the owner's submission of video tapes appeared to be unrepresentative of the reports from the survey described in Chapter 3. For example, the reported prevalence for some signs, e.g. *rubbing the nose on objects*, *rubbing the nose on the foreleg* and *striking out with the foreleg*, was much lower in the videotape exercise than was reported in the general survey. This limited the ability to properly assess the reliability of the owner reports for these signs because, although the agreement as to the absence of the sign could be assessed, there were insufficient positive reports to assess the extent of the agreement within or between owners that the sign was present.

The clarity of the horse clip would have also had an effect on the ability of the owners to agree as to the presence or absence of a sign. Two horse clips (4 and 13) featured more than twice in the 'disagreement' range of the plot of scores for the signs. This may have been caused by the lack of clarity of the clip and the short duration of the appearance of each sign. There was considerable disagreement as to the presence of *vertical headshaking* for horse clips 4, 7 and 14. The latter two horses were not on the headshaking database and the owners were in considerable agreement that these two horse did not *act like a headshaker*. Given this, it is perhaps not surprising that there was some disagreement as to whether these horses exhibited what they considered to be *vertical headshaking* (although they did move their heads up and down in the clip). The extent of headshaking movement in horse 4 was relatively small which probably contributed to the disagreement in this clip. The disagreement between owners for *rubbing the nose on objects* probably derived from some confusion with the meaning of 'object' and the lack of clear examples of this in the videotapes (only one horse rubbed on an 'object'–the owner). The two horses that appeared in the disagreement range for this sign were horse 11, which actually rubbed its nose on the ground and horse 17 which rubbed its nose on its foreleg. However, since 'rubbing the nose' probably has the same cause and function regardless of the surface to which it is applied, inconsistency here is arguably less important.

The average within-owner agreement with regards to whether the horse in question behaved 'like a headshaker' (in their understanding of the word) was 80%. The agreement between-owners was lower than this at 69%, which was the lowest agreement achieved for all the questions. The owners were more likely than not to consider that the horse did in fact 'act like a headshaker', which might be expected if all but two were considered by their owners to have a headshaking problem and had been included in the headshaking database. Owners were in some, but not complete, agreement as to the lack of headshaking behaviour in four horse clips. Two of these were the 'control' horses. The other two were not reported by the majority of owners to show 'any form of headshaking', *snorting/sneezing* or 'acting like a bee flew up the nose'. Since these behaviours were most predictive of the owners' decision to say the horse acted like headshaker, this is not surprising. There was considerable disagreement regarding whether the horse 'acted like a headshaker' for five horses. One of these was shown headshaking at rest (horse 1) and as such some owners may have been more conservative about their evaluation. For the remaining horse clips there was some disagreement over the presence of headshaking or other signs, which might explain disagreement for the overall decision. It seems that the owners are using the presence of headshaking to identify headshakers. However, it is evident from this video exercise that headshakers may not necessarily present with clearly defined headshaking behaviour (or other signs) on any given day. They may not for example 'act like bee flew up the nose' which was a description highly predictive of the decision to say the horse 'acted like a headshaker'. This suggests that a single 'snap shot' of a headshaker, even if it is displaying some signs, may not be representative of its full pattern of behaviour. As a result, more than one viewing of the horse may be necessary for a proper diagnosis to be made (at least by the owner).

The results from the videotape exercise suggest that the agreement within- and between-owners with regard to the identification of headshaking signs was high. There was particularly good evidence for high agreement within- and between- owners for the signs *snorting/sneezing*, *rubbing the nose on the foreleg*, and *dropping the nose to the ground*. Owners were least consistent in identifying the various directional planes of the headshaking movement which might have implications for the reliability of their reports for these signs. However, a general measure covering *any form of headshaking* increased their consistency to a level that was considered to represent good agreement. The ability to assess the extent of the agreement for some signs was affected by the selection of the horse clips and the prevalence of the signs within the videotapes used. Owners were least consistent with regards to their decision to rate the horse as *acting like a headshaker*. This suggests that, amongst owners at least, a short, single assessment of a horse is unlikely to produce a reliable diagnosis. Given the lack of evidence for inconsistent reporting within-owners, the subject of the next chapter will be the evaluation of the consistency of their reports from one survey to the next.

Chapter 7

Part III

The consistency of owner reports:

2. Consistency in reported headshaking signs over time

7.1 Introduction

The videotape exercise described in Chapter 6 provided evidence that owners showed a high level of consistency in their reports of the presence of headshaking signs in the same 1-minute clip of headshaking behaviour viewed approximately 2-weeks apart. Average percentage agreement within 24 owners was higher than 80% for highly prevalent signs of headshaking; *vertical headshaking*, *dropping the nose to the ground*, *flipping the top lip/nose* and *snorting/sneezing*. However, consistency when watching video clips does not necessarily imply that the owners will be consistent at reporting the signs of headshaking in their own horse in the form of a questionnaire. It is important to evaluate the consistency of owner reports in questionnaires since it is these that have been used to describe the headshaking condition in Mills *et al.* (2002a), Madigan and Bell (2001) and the survey described in Chapters 3–5.

The fact that 84 owners who completed the survey described in Mills *et al.* (2002a–Q1998) also completed one two years later (Q2000 and described in Chapters 3–5) allows the consistency of their reports between these two to be compared. A comparison between surveys will allow a larger range of signs to be compared including some important ones such as, e.g. *rubbing the nose on objects*, that were not evaluated in the videotape exercise because of the infrequency of their appearance in a one-minute clip of each horse. The reported effect of various environmental situations on the horse's problem can also be compared between the surveys. However, consistency between the reports of the presence of and effect of various situations on the headshaking signs does not only reflect consistency in the owners reports but consistency in the presentation of the headshaking condition between the two surveys. Unfortunately, separating the two is difficult, but asking the owner if the horse's headshaking has altered will go some way to assessing whether any change in the reported presentation of the condition is more likely to be due to progression of the problem than inconsistent reporting.

7.2 Aims

1. To test the null hypothesis that there is no difference in the reports of owners regarding the presence of behavioural signs in their horse in a survey completed in 1998 and another completed in 2000.
2. To test the null hypothesis that there is no difference in the reports of owners regarding the effect of various environmental situations on their horse in a survey completed in 1998 and another completed in 2000.

7.3 Methods

7.3.1 Questionnaires used in the comparison

84 horse owners had completed a questionnaire regarding their headshaker on two separate occasions, once in 1998 (Q1998) and then in 2000 (Q2000), see Chapter 3. It was possible to compare the answers from 83 of these to a range of questions regarding the horse's behaviour and its response to riding in certain situations. The wording of some of these questions in Q2000 had been altered somewhat since Q1998 in order to obtain more data from the owner. Only those questions where it was considered that the same information was being sought were compared, and these are listed in Table 7.1. In total, the presence of seven headshaking signs and the effect of riding in five situations were compared.

Table 7.1. The wording of the questions regarding the presence of headshaking signs and the effect of riding in certain situations in Q1998 and Q2000.

Sign/ Condition	Q1998	Q2000
Horizontal headshaking	Does the horse shake its head from side to side?	Any tick for *horizontal headshaking*
Vertical headshaking	Does the horse shake its head up and down?	Any tick for *vertical headshaking*
Nose-flipping	Does the horse appear to flip its nose?	Any tick for *flipping of the top lip/nose*
Snorting or sneezing	Does the horse snort or sneeze with the headshaking?	Any tick for *snorting* or *sneezing*
Nose on ground	Does the horse rub its nose on the ground whilst stationary/whilst moving?	Any tick for *dropping the nose to the ground*
Rubbing on objects	Does the horse rub its nose on objects?	Any tick for *rubbing nose on objects*
Striking at face	Does the horse strike at its face with a foreleg?	Any tick for *striking of foreleg onto nose*
Excitement	Does the horse headshake more (2) less (0) or the same (1) when excited?	How is the headshaking affected when your horse is feeling excited? (improves (0), worsens (2), not affected (1))
Bright, sunny days	Is the headshaking better (0) worse (2) or the same (1) on bright, sunny days?	How is the headshaking affected by riding on bright, sunny days? (improves (0), worsens (2), not affected (1))
Rainy days	Is the headshaking better (0), worse (2) or the same (1) on rainy days?	How is the headshaking affected by riding in the rain? (improves (0), worsens (2), not affected (1))
Night	Does the horse headshake more (2), less (0) or the same (1) at night?	How is the headshaking affected by riding at night? (improves (0), worsens (2), not affected (1))
Indoors	Does the horse headshake more (2), less (0) or the same (1) indoors?	How is the headshaking affected by riding indoors? (improves (0), worsens (2), not affected (1))

In Q1998, for each of the headshaking signs there were two response categories (presence of sign, yes or no). In Q2000, the owner ticked if the sign occurred in each of four situations 'when stabled', 'when grazing', 'when being ridden' and 'after being ridden'. The response in this instance was converted into presence of sign (yes) if the owner had indicated the presence of the sign in any one of these situations and absence of sign (no) if they had not. The response to the question in Q2000 'How does the headshaking compare to last year?' (better–0, same–1, worse–2) was presented in order to assess the likelihood of change in the condition between the surveys. The extent of the change reported in the horses would affect the expected level of agreement between the surveys.

7.3.2 Analysis of agreement

For each of the headshaking signs there were two possible responses; sign present (Y) or sign absent (N). The reported prevalence of each of 7 headshaking signs was compared between the surveys of Q1998 and Q2000. For each survey and headshaking sign this was calculated as the number of positive reports (Y) divided by the total number of horses, N=83. A comparison was also made of the owner's report of their horse in Q1998 with Q2000. For each possible combination of response in the Q1998 and Q2000 the number of owners was recorded. Possible combinations of agreements for each sign for each horse were that the owner responded 'yes' in Q1998 and 'yes' in Q2000 (YY), or 'no' in Q1998 and 'no' in Q2000 (NN). Possible patterns of disagreement between the surveys were 'yes' in Q1998 and 'no' in Q2000 (YN), or 'no' in Q1998 and 'yes' in Q2000 (NY). McNemar's paired sample test (Q_M) was used to test the association between survey (Q1998 or Q2000) and presence of each headshaking sign (yes or no). This test looks at the differences between the counts of discordant pairs (i.e. YN and NY) relative to the counts of concordant pairs (i.e. YY and NN). Exact p-values were calculated where applicable. A p-value <0.05 was taken to suggest that there was a greater tendency for owners in one survey to report the presence of a sign than in the other. Bowker's test of symmetry (Q_B) was used to test the association between survey and the reported effect of riding in certain situations as there were three response categories for these questions (improves, worsens, not affected). See Section 2.3.2 for a more detailed explanation of these tests.

The percentage of concordant pairs between the surveys (i.e. YY or NN) was calculated and given as the measure of the extent of the agreement. It was decided *a priori* to conservatively define agreement as 'good' if there was 80% concordance or higher, 'moderate' if concordance was between 60-79% and 'poor' if concordance was less than 60%. A measure of chance-corrected agreement such as kappa was not provided for the reasons discussed in Section 6.3.4.1. Differences in the reported prevalence of signs between the two occasions may have given rise to inaccurate kappa values that would not be directly comparable between signs.

To test whether there was any evidence to suggest that owners that considered their horse to have altered in severity since the previous year were more likely to disagree between the surveys, the total number of disagreements for the signs (out of a maximum of 7) was compared between owners that considered their horse to have changed (for better or worse) and those that hadn't. The significance of any difference between the two means was tested for using the two sample t-test.

7.4 Results

7.4.1 Intra-owner agreement with respect to the signs of headshaking

The most commonly reported signs in both surveys were *vertical headshaking* and *snorting*, reported in over 90% and 80% of horses respectively, see Table 7.1. *Horizontal headshaking* was the least commonly reported sign in both years (23% in Q1998 and 31% in Q2000). The extent of disagreement did not differ significantly between the surveys, with the exception of *nose flipping* ($Q_M = 12.46$, $p<0.001$) and *striking at face* ($Q_M = 5.54$, $p = 0.019$). More owners reported these signs in the Q1998 survey.

Table 7.1. The percentage of horses reported with each of the listed behavioural signs in Q1998 and Q2000 (*N*=83). The rank order of prevalence of each sign is shown in parentheses for both surveys. Shaded cells indicate significant differences between the surveys (McNemar's test, p-value, exact p in parentheses).

Behavioural sign	% of horses reported with the sign (rank order)				Q_M	p
	Q1998		Q2000			
Vertical headshaking	92%	(1)	92%	(1)	0.00	(1.000)
Snorting/ sneezing	80%	(2)	86%	(2)	1.67	0.197
Nose-flipping	77%	(3)	55%	(5)	12.46	<0.001
Rubbing nose on objects	76%	(4)	78%	(3)	0.25	0.617
Striking at face	64%	(5)	49%	(6)	5.54	0.019
Nose on ground	60%	(6)	58%	(4)	0.15	0.695
Horizontal headshaking	23%	(7)	31%	(7)	2.58	0.108

Agreement within owners was good for *vertical headshaking* (88% agreement), *snorting/sneezing* (82%) and *rubbing the nose on objects* (81%), see Table 7.2. For example, 71 owners agreed with their assessment in Q1998 that their horse displayed *vertical headshaking* and 5 agreed that it did not. 5 owners reported the presence of the sign in Q1998, but not in Q2000 and 5 owners did the reverse, i.e. there were 10 discordant owners compared to 73 that were consistent. Owners were less consistent with regards to *horizontal headshaking* (77% agreement), *striking at the face* (69%), *nose on ground* (67%) and *nose-flipping* (67%). For example, 26 owners were not consistent in their reporting of *nose-flipping* between the surveys compared to 67 who were.

Table 7.2. Intra-owner agreement of the presence (Y) or absence (N) of behavioural signs in the first questionnaire, Q1998 and in the second, Q2000 (*N*=83). Signs are listed in descending order of agreement.

Behavioural sign	1998 (Y) 2000 (Y)	1998 (Y) 2000 (N)	1998 (N) 2000 (Y)	1998 (N) 2000 (N)	% Agree
Vertical headshaking	71	5	5	2	88%
Snorting/sneezing	61	5	10	7	82%
Rubbing on objects	56	7	9	11	81%
Horizontal headshaking	13	6	13	51	77%
Striking at face	34	19	7	23	69%
Nose on ground	36	14	12	21	67%
Nose-flipping	42	22	4	15	67%

7.4.2 Intra-owner agreement with respect to the effect of certain situations on the headshaking

There was moderate intra-owner agreement for the effect of riding *indoors* (73% agreement), riding on *bright, sunny days* (72%) and riding on *rainy days* (67%). Agreement was poor for the effect of riding *when excited* (58%) and riding *at night* (55%). There was a significant association between the reporting of the effect of the situation for *bright, sunny days* and the year of the survey, with more owners than expected reporting there to be no effect of *bright, sunny days* in the 1998 questionnaire ($Q_B = 9.37$, DF = 3, p-value = 0.025) ($p>0.05$ in all other instances).

7.4.3 Owner reports of the change in severity of the headshaking

In Q2000, 74 of the 83 owners felt they could compare their horse's headshaking severity with the previous year. Of these, 45% (33) reported that it had improved, 43% (32) that it was just the same and 12% (9) that it had deteriorated.

The mean number of disagreements did not differ significantly between owners that believed that the severity of their horse's headshaking had changed from the previous year (mean 1.7 disagreements, SD 1.14, $N = 42$) and those who believed it had not (mean 1.7 disagreements, SD 1.33, $N = 32$) (2-sample t-test; $t = -0.07$, DF = 72, p = 0.943).

Table 7.3. Intra-owner agreement of the effect (worse, better, same) of riding indoors (INDOOR), bright, sunny days (SUN), rainy days (RAIN), when the horse is excited (EXCITED) and riding at night (NIGHT) on their horse's headshaking in the first questionnaire (Q1998) and the second (Q2000). Shaded cells indicate agreements. Signs are listed in descending order of agreement.

Q1998	Q2000				Agreement
INDOOR	Worse	Same	Better	TOTAL	
Worse	0	0	0	0	
Same	2	6	3	11	73%
Better	0	9	31	40	
TOTAL	2	15	33	51	
SUN	Worse	Same	Better	TOTAL	
Worse	45	4	2	51	
Same	15	11	0	26	72%
Better	0	1	0	1	
TOTAL	60	16	2	78	
RAIN	Worse	Same	Better	TOTAL	
Worse	8	2	1	11	
Same	4	5	4	13	67%
Better	2	10	33	45	
TOTAL	14	17	38	69	
EXCITED	Worse	Same	Better	TOTAL	
Worse	29	7	1	37	
Same	10	12	8	30	58%
Better	5	2	4	11	
TOTAL	44	21	13	78	
NIGHT	Worse	Same	Better	TOTAL	
Worse	0	0	2	2	
Same	1	5	3	9	55%
Better	3	8	16	27	
TOTAL	4	13	21	38	

7.5 Discussion

Agreement within owners was good for some of the most prevalent headshaking signs, *vertical headshaking* (88% agreement), *snorting/sneezing* (82%) and *rubbing the nose on objects* (81%). The agreement within owners for the effect of certain situations on the headshaking was also reasonable. This suggests not only that the consistency within owners for these signs is particularly good but also that horses do not tend to alter in their presentation of these signs from year to year. Agreement was moderate for *horizontal headshaking* (77% agreement), *striking at the face* (69%), *nose on ground* (67%) and *nose-flipping* (67%). For *striking at the face* and *nose-flipping* lower percentage agreement was due to a bias in reporting, with owners in the first survey being more likely to report these signs and may have been caused by the change in wording between the two surveys. For example, whether the horse appeared to 'flip its nose' (as worded in Q1998) might have been interpreted as a description of the headshaking movement itself (see McDonnell 2003, Madigan *et al.* 1995) resulting in it been reported more often than 'flipping of the top lip/nose' (as worded in Q2000). Signs that remained similarly worded between the surveys, such as *rubbing the nose on objects,* achieved greater agreement. The implications of these changes were not anticipated before administering Q2000 and, in any case, Q2000 had other purposes than assessment of agreement with Q1998.

There are a number of reasons that might have contributed to inconsistency of reports between the surveys, in addition to changes in the phrasing of the behavioural signs. There was also some change to the manner in which owners reported the presence or absence of each of the headshaking signs between the two surveys. The questions regarding presence of each of the signs in the earlier survey had two response options, yes or no. In the later survey this method was modified to ticking boxes to indicate whether the horse showed each sign 'when stabled', 'when grazing', 'when being ridden' and 'after exercise'. Also, by the time of the second questionnaire and perhaps as a consequence of completing the first, the owner's perception of their horse's problem may have changed. An increase in vigilance following the previous survey and resulting correspondence from the researchers may have made them more likely to report behaviours and associations with the headshaking. Both these factors could have created a tendency for increased reporting of signs, but there was no evidence of increased reporting of the signs in Q2000 compared to Q1998. The increased reporting of an effect of riding on *bright, sunny days*, however, may have been a consequence of the latter suggestion.

A comparison of the reports of owners on two different occasions measures not only the consistency of the owner's reports but the temporal stability of the signs. The lack of evidence for increased reporting of signs in the second survey might suggest that overall deterioration was not reported in these horses, or, that if deterioration did occur, it was not reflected in an increased number of signs being reported. Both suggestions can be supported by the reports from the owners. 67% of owners reported that their horse's headshaking had changed from the previous year, mostly for the better. This may explain the lower number of horses being reported with *nose-flipping* and *striking at the face* in the later survey. However, there was no evidence to suggest that those that had claimed the headshaking had changed were more likely to report the presence of signs differently between the surveys. Lack of overall deterioration in the horses both from the owners' assessment and their reporting of signs is surprising. One might have expected that deteriorating cases would be more likely to respond to a second survey.

The consistency of the reports of owners during the videotape exercise described in Chapter 6 was above 80% agreement for the major signs, including *vertical headshaking* and *snorting/sneezing*. The consistency of their reports between two separate surveys, described in this chapter, was found to be a similar magnitude for these signs, and also for *rubbing the nose on objects*. This suggests that, despite differences in the wording of the surveys and the probability that the horses had altered to some extent in their severity, both the consistency of the owner's reports and the persistence of the major signs is high. This gives us more confidence in the reliability of owners as reporters of their horse's behaviour, at least when it is based on general recall. How this might compare to a single observation of their horse's behaviour is the subject of the next chapter.

Chapter 8

Part III

The consistency of owner reports:

3. Owner recall compared to a single observation

8.1 Introduction

Chapters 3–5 presented the prevalence of headshaking signs in 200 horses and described how the severity of these signs was reported to alter with changes in the horse's local environment. The results suggested that the presentation of signs can vary considerably, not only between horses but, also within the same horse over time. For example, headshaking severity and occurrence was reported to change with the prevailing weather conditions (e.g. bright, sunny days), the locomotory state of the horse, the location in which it is exercised, as well as with the seasons. These apparent phenomena raise the question of how reliable a single assessment of the presentation and severity of the headshaking in a horse is going to be. This is particularly pertinent when a veterinary surgeon is called to examine a horse suspected to be suffering from headshaking syndrome and they have only a short visit on which to base their assessment. Regardless of the surgeon's skills in identifying the clinical signs of headshaking, it is questionable how representative of the horse's headshaking problem their assessment will be. Owners frequently report that on the day the surgeon attended the horse, the horse did not show any, or few, signs of the syndrome, even if the prevailing weather conditions were believed to be conducive to their appearance (pers. obs.). This difficulty was also appreciated in the construction of the videotape of headshakers in Chapter 6. Several, commonly reported signs such as *rubbing the nose on objects* and 'acting like a bee flew up the nose' were observed infrequently in the short video clips which made it difficult to assess the reliability of owners' reports of these.

The consequences of an assessment which is unrepresentative of the overall, current severity and/or presentation of the headshaking are not only embarrassment and increased expense for the owner (if a repeat visit is required). Since the diagnosis and selection of appropriate treatments rely on an accurate description of the clinical signs and severity of the condition, an incomplete picture of the extent of the horse's headshaking problem may prove detrimental to the horse. It may also impact on the reliability of any assessment of the response to interventions for the prevention or treatment of the headshaking.

For these reasons it is important to establish if there are differences in the reporting of signs between a single observation of the horse during exercise and a report based on recent recall of events. This can be done using owners as the assessor since they usually hold the general picture of the horse's current state of headshaking. Comparing their reports from a single exercise session with their reports in a survey will test the consistency between the two reporting methods because it uses the same person for each.

However, the validity of their reports also needs to be assessed. For example, would an owner and a veterinary surgeon agree that they have observed the same headshaking signs in a given horse? This is important to establish if owners are to be considered as useful assessors of their horse's behaviour in past and future research. The extent to which their observations might agree with someone who is suitably trained and independent (like a veterinary surgeon) can be evaluated by comparing their assessment of a horse during the same exercise session.

8.2 Aims

1. To test the null hypothesis that there is no difference in the reporting of headshaking signs by a horse owner in a single observation of their horse and an assessment based on recall of recent events (i.e. a survey).

2. To test the null hypothesis that there is no difference in the reporting of headshaking signs by a horse owner in a single observation of their horse and a trained, independent observer observing the same exercise session (via a video recording)

8.3 Methods

8.3.1 Assessment procedures

The assessment of the presence of headshaking signs based on owner recall was taken from the survey described in Chapter 3 (Q2000), using the answers to the section regarding behavioural signs, see Appendix III. This section inquired about the presence of 27 signs when the horse was 'stabled', when 'in the field', 'when ridden' and 'after exercise'.

The single assessment was a lunging exercise, which the owners who had participated in the survey were also asked to complete. During the period 1st June to 1st September 2001, respondents to the Q2000 survey were sent a lunging exercise sheet with the questionnaire. (Participants who had returned their survey prior to June 1st were sent the lunging exercise separately). The exercise requested owners to seek a friend's help to lunge their horse for 20 minutes in a suitable area whilst they marked down the appearance of the headshaking signs. The signs were listed exactly as they had been in the survey. See Appendix V for a copy of the lunging exercise instruction sheet.

The owners were requested to make the horse walk for the first 5 minutes and then trot for the remaining 15, with a change of rein halfway through the exercise. The lunging test was divided into four 5-minute sections and the owners were instructed to tick all the signs that appeared during each section. Amongst other details, the owners were asked at the end of the test to evaluate whether the severity and the number of signs observed in their horse during the exercise had been better or worse than that seen normally on 'other days in the headshaking season' or when 'riding out' (i.e. taking the horse on a hack in the local area). Owners were encouraged to videotape the lunging exercise. This enabled an independent observer (the author) to record the presence of the signs for each horse in the same manner as the owner did at the time of the recording. This was only possible for video recordings of the complete test.

8.3.2 Statistical analysis

8.3.2.1 Reported prevalence of signs

All recorded lunging exercises lasting at least 10 minutes were included in the analysis even if no signs had been reported. 50 lunging exercises were therefore included. The presence of each of the 27 listed signs (see Appendix V) was recorded for each horse if it was reported to have occurred at any point during the lunging exercise. The prevalence of each sign was calculated as the number of reports of the sign divided by the total number of horses (N=50). This was compared to the reported prevalence of each sign in the 'when ridden' column only of the Q2000 survey regarding the same 50 horses. The ranking of the signs by reported prevalence was presented for both lunging exercise and survey. The total number of signs reported in each horse before abandonment of the lunging exercise was compared to that reported in the survey and the significance of this difference tested using the Wilcoxon signed-rank test.

8.3.2.2 Within-owner agreement

For each of the 27 headshaking signs there were two possible responses; sign present (Y) or sign absent (N). A comparison was made of the owner's report of their horse in the lunging exercise with the survey. For each possible combination of response in the survey and the lunging exercise the number of owners was recorded. Possible combinations of agreements for each sign for each horse were that the owner responded 'yes' in the survey and 'yes' in the lunging exercise (YY), or 'no' in the survey and 'no' in the lunging exercise (NN). Possible patterns of disagreement were 'yes' in the survey and 'no' in the lunging exercise (YN) or 'no' in the survey and 'yes' in the lunging exercise (NY). McNemar's paired sample test (Q_M) was used to test the association between assessment method (survey or lunging exercise) and presence of each headshaking sign (yes or no). This test looks at the differences between the counts of discordant pairs (i.e. YN and NY) relative to the counts of concordant pairs (i.e. YY and NN). Exact p-values were calculated where applicable. A p-value <0.05 was taken to suggest that there was a greater tendency for owners in one assessment method to report the presence of a sign than in the other. See Section 2.3.2 for a more detailed explanation of this test.

The percentage of concordant pairs in the survey and lunging exercise (i.e. YY or NN) was calculated and given as the measure of the extent of the agreement. It was decided *a priori* to conservatively define agreement as 'good' if there was 80% concordance or higher, 'moderate' if concordance was between 60-79% and 'poor' if concordance was less than 60%. A measure of chance-corrected agreement such as kappa was not provided for the reasons discussed in Section 6.3.4.1. Differences in the reported prevalence of signs may have given rise to inaccurate kappa values that would not be directly comparable between signs. The percentage agreement was not presented for signs with a reported prevalence of less than 30% in both lunging exercise and survey since there would be insufficient reports to reliably determine agreement.

8.3.2.3 Owner-independent observer agreement

A total of 12 complete videos of the lunging exercise were available from the 50 horses for evaluation by an independent observer. The agreement between the independent observer (when watching a video of the lunging exercise) and the owner (at the time of the lunging exercise) with regard to the reporting of presence of the same 27 signs was analysed in the same manner as described above for within-owner agreement. Some signs could not be reliably seen in all videos by the observer and were therefore not compared with the reports by the owner. Signs omitted from the analysis for this reason were: *clamping the nostrils, odd/heavy breathing, signs of inflammation, sweating, nasal discharge, twitching, watering eyes, blinking, heavy eyelids/dopey expression* and *staring into space,* in addition to those reported by the owner and independent observer with less than 30% prevalence.

8.4 Results

8.4.1 Percentage of horses reported with headshaking signs in the survey and the lunging exercise

The most commonly reported signs during exercise in both the survey and the lunging test were *vertical headshaking* and *snorting*, see Table 8.1. There was no evidence of a significant effect of method of report (survey or lunging exercise) on the proportion of owners that reported the presence of these signs. However, for many of the other signs there was a consistent pattern of fewer horses reported with the sign during the lunging exercise, compared to the survey, see Table 8.1. There were significant discrepancies in 10 of the 27 signs; *rubbing the nose on the foreleg* (Q_M = 30.00, exact p<0.001), *rubbing the nose on objects* (Q_M = 16.33, exact p<0.001), *striking out with the foreleg* (Q_M = 14.22, exact p<0.001), *sneezing* (Q_M = 11.84, p<0.001), *striking of foreleg onto the nose* (Q_M = 10.89, exact p = 0.001), *stumbling/in-coordination* (Q_M = 9.00, exact p = 0.004), *watering eyes* (Q_M = 8.33, exact p = 0.006), *coughing* (Q_M = 6.23, p = 0.023), *rushing forward/panicking* (Q_M = 4.76, p = 0.029) and *flipping the nose/top lip* (Q_M = 4.00, p = 0.046). In particular, *rubbing the nose on the foreleg* was less commonly reported during the lunging exercise (20% prevalence) compared to the survey where it featured as the third most prevalent sign (80% prevalence). Similarly large discrepancies were seen for *sneezing, striking out of the foreleg, striking of the foreleg onto the nose* and *rubbing the nose on objects* which were all much less commonly reported to have occurred during the lunging exercise and as a result were ranked lower in order of prevalence than they were in the survey.

Table 8.1. The percentage of horses reported with each of the listed headshaking signs during exercise in the survey and lunging exercise (N=50). The rank order of prevalence of each sign is shown in parentheses for both surveys. Shaded cells indicate significant differences between the surveys. Results from McNemar's test, Q_M, and associated p-value (exact) are also given.

Behavioural sign	% prevalence (rank order) Survey		Lunge test		Q_M	P
Vertical headshaking	94%	(1)	86%	(1)	1.60	(0.344)
Snorting	84%	(2)	68%	(2)	2.25	(0.210)
Rubbing nose on foreleg	80%	(3)	20%	(12)	30.00	(<0.001)
Sneezing	60%	(4)	30%	(6)	11.84	<0.001
Dropping nose to ground	58%	(5)	50%	(3)	0.73	0.394
Flipping of top lip/nose	54%	(6)	38%	(4)	4.00	0.046
Striking out of foreleg	54%	(6)	22%	(10)	14.22	(<0.001)
Striking of foreleg onto nose	50%	(8)	22%	(10)	10.89	(0.001)
Rubbing nose on objects	50%	(8)	8%	(22)	16.33	(<0.001)
Twisting/rotary headshaking	48%	(10)	38%	(4)	1.32	0.251
Rushing forward/panicking	44%	(11)	26%	(8)	4.76	0.029
Horizontal headshaking	36%	(12)	30%	(6)	0.47	0.491
Coughing	34%	(12)	16%	(16)	6.23	0.023
Stumbling/in-coordination	34%	(14)	16%	(16)	9.00	(0.004)
Odd head carriage	30%	(15)	26%	(8)	0.29	0.593
Nasal discharge	30%	(15)	18%	(13)	2.57	(0.180)
Unwillingness to move	30%	(15)	18%	(13)	4.50	(0.070)
Twitching	22%	(16)	14%	(19)	2.00	(0.289)
Sweating	22%	(16)	14%	(19)	2.00	(0.289)
Watering eyes	22%	(26)	2%	(25)	8.33	(0.006)
Odd/heavy breathing	16%	(21)	10%	(21)	1.80	(0.375)
Clamping the nostrils	14%	(22)	16%	(16)	0.14	(1.000)
Heavy eyelids/dopey	10%	(23)	8%	(22)	0.20	(1.000)
Blinking	6%	(24)	18%	(13)	3.60	(0.109)
Other	6%	(24)	8%	(22)	0.20	(1.000)
Staring into space	6%	(24)	0%	(26)	Not calculated	
Signs of inflammation	4%	(27)	0%	(26)	Not calculated	

8.4.2 The number of signs reported per horse in the survey and the lunging exercise

There was a significant difference between the survey and lunging exercise in the total number of signs reported in each horse (Wilcoxon signed-rank test, $Z = 5.37$, $N = 44$ for test, $p<0.0001$). The mean number of signs reported per horse in the survey was 10.0 (SD 4.23, median 10, range 1–21) compared to 6.2 in the lunging exercise (SD 3.16, median 6, range 0–14).

8.4.3 Intra-owner agreement with respect to the presence of headshaking signs during the lunging exercise and the survey

The extent of the concordance within the owners with respect to the reporting of headshaking signs during the lunging exercise and in the survey varied considerably. The percentage agreement ranged from 40% to 84%, see Table 8.2. Agreement within owners was good for *unwillingness to move* (84%), *stumbling/in-coordination* (82%) and *vertical headshaking* (80%). However, the reported prevalence of the first two signs was very low and for the third particularly high, making agreement by chance for them more likely. Owners were moderately consistent (between 60–79% agreement) for signs that were relatively prevalent in the questionnaire such as *snorting*, *flipping of the top lip/nose*, *striking out of the foreleg*, *striking of the foreleg onto the nose* and *sneezing*. There was poor agreement for *dropping the nose to the ground* (56% agreement), *rubbing the nose on objects* (46%) and *rubbing the nose on the foreleg* (40%). The disagreement for the latter two signs arose from them being significantly less likely to be reported during the lunging exercise.

Table 8.2. Agreement within owners of the presence (Y) or absence (N) of headshaking signs in the survey (S) and the lunging exercise (L) (*N*=50). Signs are listed in descending order of agreement.

Behavioural sign	S (Y) L (Y)	S (Y) L (N)	S (N) L (Y)	S (N) L (N)	% Agreement
Unwillingness to move/stopping	8	7	1	34	84%
Stumbling /in-coordination	8	9	0	33	82%
Vertical headshaking	40	7	3	0	80%
Coughing	6	11	2	31	74%
Odd head carriage	7	8	6	29	72%
Nasal discharge	5	10	4	31	72%
Snorting	31	11	5	3	68%
Flipping of top lip/nose	15	12	4	19	68%
Rushing forward /panicking	9	13	4	24	66%
Striking out of foreleg	10	17	1	22	64%
Striking of foreleg onto nose	9	16	2	23	64%
Sneezing	13	17	2	18	62%
Twisting/rotary headshaking	12	12	7	19	62%
Horizontal headshaking	7	11	8	24	62%
Dropping nose to ground	16	13	9	12	56%
Rubbing nose on objects	1	24	3	22	46%
Rubbing nose on foreleg	10	30	0	10	40%

Signs not evaluated as they had a reported prevalence of less than 30% in both instances were: *twitching, sweating, watering eyes, odd/heavy breathing, clamping the nostrils, heavy eyelids/dopey expression, blinking, other, staring into space and signs of inflammation.*

8.4.4 Owner assessment of the difference in the severity and number of signs reported in their horses during the lunging exercise compared with 'other days in the headshaking season' and when 'riding out'.

Over 60% of owners reported that the severity of their horse's headshaking during the lunging exercise was different compared with 'riding out', see Table 8.3. Of these, over twice as many reported that they were better (rather than worse) during the lunging exercise compared to being ridden out (47% compared to 15%). The remainder of owners, approximately 40%, claimed that the severity was no different in the lunging exercise compared to riding out. This pattern was mirrored in the number of signs and also in the comparison between the lunging exercise and 'other days in the headshaking season'. Two owners reported no signs at all during the lunging exercise and an additional six had declined to complete a lunging exercise claiming their horse did not usually show signs when being lunged.

Table 8.3 The percentage of owners reporting a difference in the severity and number of signs observed in their horse during the lunging exercise compared with 'riding out' and 'other days in the headshaking season'.

	Compared with riding out		Compared with other days	
Comparison	**Severity**	**No. of signs**	**Severity**	**No. of signs**
Much better	21%	20%	28%	24%
Better	26%	30%	22%	27%
Same	38%	43%	42%	41%
Worse	9%	2%	7%	7%
Much worse	6%	5%	2%	0%
N	47	44	45	44

8.4.5. Owner-independent observer agreement regarding the presence of headshaking signs during the lunging exercise

A comparison between an independent observer and the owner with regard to the reporting of the signs during a single lunging exercise was possible for 12 horses. The agreement between the observer and owner is listed in Table 8.4, together with the overall percentage agreement for each sign. *Dropping the nose to the ground*, *vertical headshaking, snorting* and *unwillingness to move* achieved good agreement (over 80% agreement). *Flipping of the top lip/nose*, *odd head carriage*, *rotary headshaking* and *striking out of the foreleg* all achieved agreement in excess of 70%. Signs for which the agreement was lower were *horizontal headshaking* (67% agreement) and *rushing forward/panicking* (58% agreement). There was no evidence of a significant difference in reporting of any the signs listed in Table 8.4 between independent observer and owner (McNemar's test, exact p value>0.05).

Table 8.4. Independent observer (I)-owner (O) agreement of the presence (Y) or absence (N) of headshaking signs during the lunging exercise (*N*=12). Signs are listed in descending order of agreement.

Behavioural sign	O (Y) I (Y)	O (Y) I (N)	O (N) I (Y)	O (N) I (N)	% Agreement
Dropping nose to ground	8	0	1	3	92%
Vertical headshaking	11	1	0	0	92%
Snorting	11	0	1	0	92%
Unwillingness to move	3	1	1	7	83%
Flipping of top lip/nose	4	3	0	5	75%
Odd head carriage	5	1	2	4	75%
Twisting/rotary headshaking	7	2	1	2	75%
Striking out of foreleg	1	3	0	8	75%
Horizontal headshaking	5	1	3	3	67%
Rushing forward /panicking	4	0	5	3	58%

Signs not evaluated as they had a reported prevalence of less than 30% by both observers were: *rubbing nose on foreleg, rubbing nose on objects, coughing, striking of foreleg onto nose and stumbling /in-coordination*

8.5 Discussion

The agreement within the owners with regards to the presence of signs reported in a survey and during a lunging exercise varied considerably from 40% to 84%. There was no significant disagreement in reported presence of *vertical headshaking* and *snorting* which were the two most prevalent signs on both occasions. However, for more than a third of the signs, owners were significantly less likely to report the presence of the sign during the lunging exercise than in the survey. In particular, *rubbing the nose on the foreleg*, *rubbing the nose on objects*, *striking of the foreleg onto the nose*, *sneezing* and *striking out of the foreleg* were reported much less frequently in the lunging exercise. In addition, owners reported more signs in the survey (on average 10 per horse) compared to the lunging exercise (6 per horse). This bias in the tendency to report signs between the survey and lunging exercise is likely to have affected the agreement possible between the two situations. The percentage agreement for the majority of signs was around the 60-70% level. Some signs achieved higher agreement but this was due in part to their high prevalence (*vertical headshaking*) or absence (*stumbling* and *unwillingness to move*), since agreement by chance becomes more likely in these situations.

The results suggest that the 'snapshot' assessment of the lunging exercise is not representative of the more global assessment in the postal survey. It is unlikely that this was caused by inconsistent reporting *per se* on the part of the owner. Agreement levels within owners between observation of a videotape (described in Chapter 6) and between surveys (described in Chapter 7) was found to be higher than that observed in this exercise. This suggests that there is some other reason to explain the discrepancy between the reports from a survey and a single observation of the horse.

The most likely explanation is the variation of the condition with time, location of the exercise and type of exercise. Variation over time is supported by the owners' assessment of the difference in the number of signs they saw in their horse between the lunging exercise and 'other days in the headshaking season'. 51% of owners reported that they observed fewer signs in their horse during the lunging exercise than on other days in the headshaking season. The sporadic nature of the syndrome may be such that horses are better on some days than others, even though it is likely the owners chose days in which their horse was likely to be particularly severe. 50% of owners also reported that they observed fewer signs in their horse during the lunging exercise compared to 'riding out and about'. A few even declined to complete the exercise because they felt that their horse would not show signs when being lunged. 'Riding out' may be more likely to expose the horse to trigger factors additional to those during lunging, for example, the use of the bit and exposure to a range of vegetation and potential airborne irritants, both of which have been implicated in the headshaking condition (Cook 1999, Mills *et al.* 2002a). 38% of horses in the survey were also reported to be better when lunged compared to being ridden (see Section 3.4.8). So, it may be that the type of exercise that the horse is undertaking and the location in which this occurs has an effect on the severity and presentation of signs. Specific discrepancies between the reported prevalence of signs such as *rubbing the nose on the foreleg, rubbing the nose on objects* and *dropping the nose to the ground* also raises the question of whether the differences in exercise type and location affect the specific presentation of the headshaking problem. For example, horses may be more likely to rub their nose on objects or their foreleg when they are ridden out and about. The length of time the horse was exercised for may have also played a part in the discrepancy between survey and lunging exercise, especially as nearly 70% of horses in the survey described in Chapter 3 were reported to deteriorate as exercise progressed.

Asking the owner to assess the horse during a single lunging exercise (albeit with someone else lunging the horse) may be less conducive to full attention to the signs the horse is showing. However, if this is the case then the same is true of an independent, trained observer who was observing signs in the relative comfort of an office. The assessment of the presence of headshaking signs was compared between the owner and the author for each horse that was videotaped. Although not a veterinary surgeon, the author was familiar with the headshaking syndrome and aware of the presentation of each of the particular signs. Agreement between the two observers was generally good with major signs such as *vertical headshaking*, *dropping the nose to the ground* and *snorting* achieving over 90% agreement. There was less agreement for perhaps more subjective signs such as *rushing forward/panicking* and for *horizontal headshaking, twisting/rotary headshaking, flipping the top lip/nose* and *striking out of the foreleg.* These signs may be harder to consistently identify because they also achieved lower agreement levels in the other consistency exercises in Chapters 6 and 7.

The results from this exercise suggest that reports by the horse owner of the severity and the presence of signs based on a single observation of the horse during the headshaking season do not fully represent their report based on recall. Although the presence of *vertical headshaking* and *snorting* were similarly reported between the two occasions there were significantly fewer reports of many other signs including *rubbing the nose on the foreleg, rubbing the nose on objects* and *striking out.* There was no evidence to suggest that the reports of the same lunging episode differed between the owner and a trained, independent observer, which suggests that the same would be true of an assessment made by a veterinary surgeon. Since rubbing the nose is one of the major signs of headshaking if this is not observed the diagnosis by the surgeon may differ. Similarly, if signs such as *striking the nose with the foreleg* are not observed then the overall severity of the horse's problem may not be appreciated. This contention is supported by the observation in Section 5.4.3 that the number of signs the horse was reported with correlated with the severity rating of the horse. If this is the case then this has implications for the diagnosis and subsequent treatment of the horse.

A more complete evaluation may be possible if the horse is observed being ridden on several occasions but these two scenarios are often not practical for the veterinary surgeon or affordable for the owner. The horse may be considered too dangerous to be ridden, there may not be a suitable riding surface available, and the surgeon may not be able to follow the owner down a leafy lane in order to 'induce' the presentation of signs. Instead, the surgeon has to rely on the owner's assessment of their horse's problem to obtain additional information not possible from a single visit. Evidence from the exercises in Chapters 6 and 7 suggests that doing so does not necessarily compromise reliability. This implies that observation of the horse for reasons other than diagnosis (i.e. response to treatment) may also benefit from utilising the reports of the owner.

Chapter 9

Part IV

Assessment of management aids for equine headshaking syndrome:

1. Methodology

9.1 Introduction

9.1.1 Efficacy studies to date

To date, the great majority of published studies regarding treatments for headshaking have been reports from clinical, referral case loads as opposed to designed trials. As a result, they have involved small sample sizes, lack of adequate controls and the inclusion of horses that might not necessarily be representative of the headshaking population at large. The use of only a small sample of horses such as that in Madigan *et. al.* (1995), where the effects of cyproheptadine and limiting light to the eyes was evaluated on only seven horses, reduces the chances of detecting a statistically significant effect. Since headshaking can be a presenting sign of many diseases, the ability to make generalisations to the wider population, from studies conducted on only a handful of horses, is especially limited. The lack of controls, such as sham treatments or placebos, in the studies by, for example, Newton *et. al.* (2000) and Mair *et. al.* (1994), means that limited judgement can be made as to whether the reported change in the headshaking behaviour was as a result of the treatment as opposed to anything else. Finally, since the horses included in these studies were cases referred to the surgeon for treatment, there is a possibility that they were more severely or differentially affected compared to other horses in the general population with a headshaking problem. This assertion is supported somewhat by the work described in Chapter 5, where the reported prevalence of signs by owners of horses that had been treated by a veterinary surgeon for the headshaking was compared to those that had not. Horses that had been treated by a veterinary surgeon were more likely to be reported with a wider range of signs, some of which might indicate a greater severity to their problem.

These criticisms aside, the reported response to many of the treatments under assessment has been relatively poor, for example neurectomy (Mair 1994), and a range of drug therapies, including dexamethasone, disodium cromoglycate and beclomethasone (Mair *et al.* 1992). However, good results have been reported with other drug therapies, e.g. carbemazepine (Newton *et al.* 2000) and cyproheptadine (Madigan *et al.* 1995) but their effectiveness has yet to be reported from the field and has been contradicted by other researchers. For example, Newton *et al.* (2000) reported that cyproheptadine alone was ineffective. A poor response to veterinary interventions has also been reported by the owners of headshakers sourced from the general population (Mills *et al.* 2002b, Madigan and Bell, 2001, Chapter 3). This, together with their potential invasiveness (e.g. neurectomies and tracheotomies), reliance on owner compliance (to administer tablets or inhalers) and/or potential side effects (e.g. lethargy with cyproheptadine (Wilkins 1997)) seems to make them unpopular with owners (Mills *et al.* 2002b). As a result, horse owners appear to be looking to alternative treatments in an attempt to alleviate the headshaking (see Chapter 2 and 3) and have reported that their effectiveness may exceed that obtained with conventional treatments (Mills *et al.* 2002b and Chapter 3).

Popular non-conventional interventions include the use of feed supplements and facial coverings. Over 70% of owners in the study by Mills *et al.* (2002b) reported trying a nose net in order to prevent headshaking attacks, and, of these, over 60% reported that it had been at least partially helpful. Over 40% of owners reported feeding various types of supplement to their headshaker, with over third of these reporting some improvement. Since it is clear that horse owners can rely heavily on treatments like these, it is important to evaluate their effectiveness at alleviating or preventing the signs of the syndrome. Only the nose net has been subject to any kind of assessment of its efficacy for preventing headshaking signs under controlled conditions (Mills and Taylor

2003). The reported efficacy of three variations of a nose net was found to reflect that reported by the owners in a previous survey. For the remainder of non-conventional therapies, to date, information about their efficacy has only been anecdotal, despite an increase in their demand from owners seeking relief for their headshakers. Thus there is the possibility that horse owners may not only be wasting time and money on ineffective products but they may actually be harming their horse by not seeking a more appropriate treatment. Alternatively, the chance that some of these therapies might actually be helpful means that a proper assessment of their efficacy is crucial if we are to learn more about the syndrome, especially since progress regarding conventional interventions has been slow.

9.1.2 Assessing efficacy

The method chosen to assess the efficacy of a particular treatment is inevitably a result of various compromises regarding the reliability and validity of various methods. Reliability refers to the extent to which the reports of the horse's behaviours are consistent and free from random errors. Unreliable reports may arise out of inconsistency in the horse's behaviour or in the observation and reporting of the behaviour. Validity concerns the extent to which the reports or use of subjects are free from non-random errors, i.e. bias in the selection of horses or in the reporting. If reports are unreliable then an effect of treatment may not be detected. If reports are not valid then the use of the study is limited since generalisations to other horses cannot be made.

The use of referral cases, as has been used in the majority of published reports, may be more valid than the use of horses assessed by their owners since they have been properly examined by qualified professionals that are not emotionally involved. Many cases, however, still depend on owner report for information on the treatment outcome. This has been defended by the acknowledgement that the observations by the owners led to the horse being presented to the veterinary surgeon for treatment in the first place (Mair *et al.* 1992). However, the validity of these case reports might be limited, if, as discussed in Chapters 4 and 5, both the presentation of the condition and the type of horse included does not reflect that in the general headshaking population. The use of horses from the general population may be a more valid method since the efficacy of the treatment in question is tested directly on the population for which it is intended. Since the reports of the owner and an independent, trained observer when assessing the presence of 10 headshaking signs in their horse did not differ significantly for any of the signs assessed (Chapter 7), the reports of owners may not be so different that of a suitably trained individual such as a veterinary surgeon.

The reliability of the reports regarding horses presented to a veterinary clinic cannot be assumed, for two reasons. Firstly, the severity and occurrence of the headshaking is often reported to vary according to the environment the horse is in. Horses have been reported to spontaneously begin or cease headshaking when moved to a different part of the country (Lane and Mair 1987, Q2000–see Section 3.4.5.4). It is not surprising, therefore, that headshakers have been reported to spontaneously improve when taken to the veterinary clinic (Mair *et al.* 1992, Newton *et al.* 2000, Knottenbelt 1998). This makes assessment of the effect of treatment, at best, somewhat unreliable and, at worst, impossible. Treatment and assessment of the horse in its home environment, in conditions that would normally be expected to trigger the headshaking, may be more appropriate. This method was supported by Mair *et al.* (1992) for this reason.

Secondly, the extent to which the severity and occurrence of a horse's headshaking problem can vary from day to day or with a change of environment suggests that a single assessment of the horse is not going to be a reliable measure. This is supported not only by owners' comments, but by a comparison of the reports of headshaking signs during a single assessment with a survey based on recall (see Chapter 8). Approximately one third of all the signs listed were less likely to be reported during the single exercise than in the survey, including some signs that are usually reported with a high prevalence such as *rubbing the nose on the foreleg*, *rubbing the nose on objects* and *striking out of the foreleg*. Therefore it is unlikely that a single assessment by a visiting veterinary surgeon, for example, or even a few single assessments at the clinic, is going to be a reliable method for assessing the overall change due to treatment. Owners can observe their horse on several occasions and are also, arguably, in the best position to mentally summarise the severity and occurrence of the headshaking since they are more aware of the usual day-to-day variation in their horse's headshaking.

The reliability of owner's reports was assessed in Chapter 6 by the use of video observation of a range of horses exhibiting a range of headshaking behaviours. Both the within-owner agreement (agreement between two, separate viewings of the same video clip by the same owner) and the agreement between owners as to whether each horse had demonstrated a range of signs was good (usually above 70%). One might argue that they would be even more consistent when assessing their own horse since they are more used to observing it.

For these reasons, it is suggested that the assessment of the effect of treatment on a horse with a headshaking problem might be better achieved in the horse's home environment under the supervision of the owner. It is also important that the owner monitors the improvement in the horse, since they make the final judgement as to whether the treatment is question is worthwhile. If the owner does not also see or recognise the benefit of a certain treatment to the performance of the horse then it cannot in all reality be regarded as effective. This chapter describes a method for assessing the efficacy of a range of non-conventional preventative therapies (referred to as 'management aids') in the horse's home environment under the supervision and observation of the owner. At each stage of the development of the methodology a justification for the methods chosen will be made. Any deviations or additions to this methodology for a particular trial will be described at the beginning of the relevant chapters which follow.

9.2 Management aids chosen for assessment

Four management aids were subjected to a field trial to assess their effect on the reported signs associated with headshaking:

- A bitless bridle (see Chapter 10)
- A light-limiting facemask (see Chapter 11)
- A magnetic head collar (see Chapter 12)
- A herbal supplement (see Chapter 13)

The management aids were chosen primarily as they had either previously been indicated in the veterinary literature for the prevention of headshaking attacks but had not been subjected to any formal trial (the face mask–Madigan and Bell 2001 and the bitless bridle–Cook 1998a, 2003) or were already on the market with only anecdotal claims as to their efficacy in alleviating headshaking symptoms (the head collar and herbal supplement). Particular indications for use with regards to the headshaking condition will be described at the beginning of each trial. Each aid was subject to a pilot evaluation by a few owners before an explicit trial of the device was considered.

9.3 Aims of testing management aids for headshaking

The purpose of each trial was two-fold:

1. To assess the effect of the aid in question on the reported signs of headshaking.
2. To evaluate *post-hoc* the characteristics of those horses that benefited significantly from the management aid in question[1].

[1] Testing for prognostic factors depended on the presence of a statistically significant change from baseline, which represented improvement in *overall severity* in a reasonable number of horses, i.e. a minimum of 10 horses experiencing 50% improvement. Since this proved not be the case for any of the management aids under assessment, the method by which this might have been achieved has not been described.

9.4 Basic trial design

9.4.1 Simple field trial

The method of assessment of the efficacy of the light-limiting face mask and the bitless bridle was similar to that of a clinical phase II trial. Phase II trials look for preliminary evidence of efficacy and side-effects only (Piantadosi 1997). Should there be sufficient evidence to indicate that the treatment in question might be effective then a more strictly controlled phase III clinical trial is conducted to compare its efficacy with other treatments or placebo. Since there was no information as to the efficacy of the face mask or the bitless bridle on the general headshaking population in the UK, a simple field trial was chosen as the method of assessment for these two management aids. The reported change was the final assessment under treatment relative to a baseline assessment.

9.4.2 Double-blind, placebo-controlled, cross-over trial

A placebo-controlled trial, more similar to a phase III clinical trial, was conducted with the magnetic headcollar and the herbal supplement. Their presence on the market for several years suggested that to some extent their safety, if not their efficacy, was more established than for the bridle or mask. Controlling by the use of a placebo was also more feasible in these cases. The use of a placebo treatment or device allows the clinician to be more confident that the reported response is due to the treatment rather than impressions affected by factors not relevant to the treatment (Pocock 1991). An important component to this is that everyone directly involved in the trial is ignorant of the identity of the treatments applied (blinding); otherwise their impression might affect the outcome. In this case the two placebo-controlled trials were 'double-blind' in that neither the patient-assessor (in this case the owner) nor the trial coordinator (in this case the researcher), knew the true identity of the two treatments until all statistical analyses had been conducted and subsequent conclusions reached.

The assessments of the headcollar and supplement were also designed as cross-over trials. Each horse was administered both treatment types and acted as its own control. Cross-over trials can be useful in reducing the variability in outcomes between placebo and verum (the treatment under evaluation). This is especially important in the case of headshaking syndrome when the presentation of the problem can vary widely between individuals. Assessment of the change in headshaking measures was still relative to a baseline assessment, one preceding each of the treatments. The second baseline period following the first treatment also acted as a 'washout' between applications of the treatments (Jones and Kenward 1989). The amount of 'carry-over' is the extent to which the first treatment might not have fully left the horse's system so that its effect is seen in the second period (Jones and Kenward 1989). Cross-over trials assume a zero carry-over effect, i.e. they assume that the washout period was sufficient to allow all effects of the first treatment to disappear. Therefore it is important that the washout period is long enough for the treatment and its mode of action. The design of the placebo-controlled, cross-over trial is illustrated in Fig. 9.1.

Horses were recruited onto the trial in blocks (of 4 for the magnetic headcollar and of 2 for the supplement). Within each block, an equal number of horses were allocated to test the verum first or the placebo. This is important since the order in which the products were tested might have an effect on the outcome due to differences in owner report and carry-over from the first period of testing. For example, owners might tend to report more improvement when testing the first product because they are more enthusiastic at the beginning of the trial. Allocation of the horses into the two groups was carried out by a representative of the manufacturer in both cases. They were instructed to do this randomly by tossing a coin. The headcollars were labelled A, with yellow tags attached, and B, with red tags attached. In the supplement trial, they were simply known to the owners as the first and second supplement and the manufacturer kept a record of who had been sent the verum first. The owners were sent each treatment in the post towards the end of the relevant baseline assessment period. In this way each treatment could not commence earlier than planned at the expense of the baseline assessment, nor could owners become confused about the identity of the two treatments.

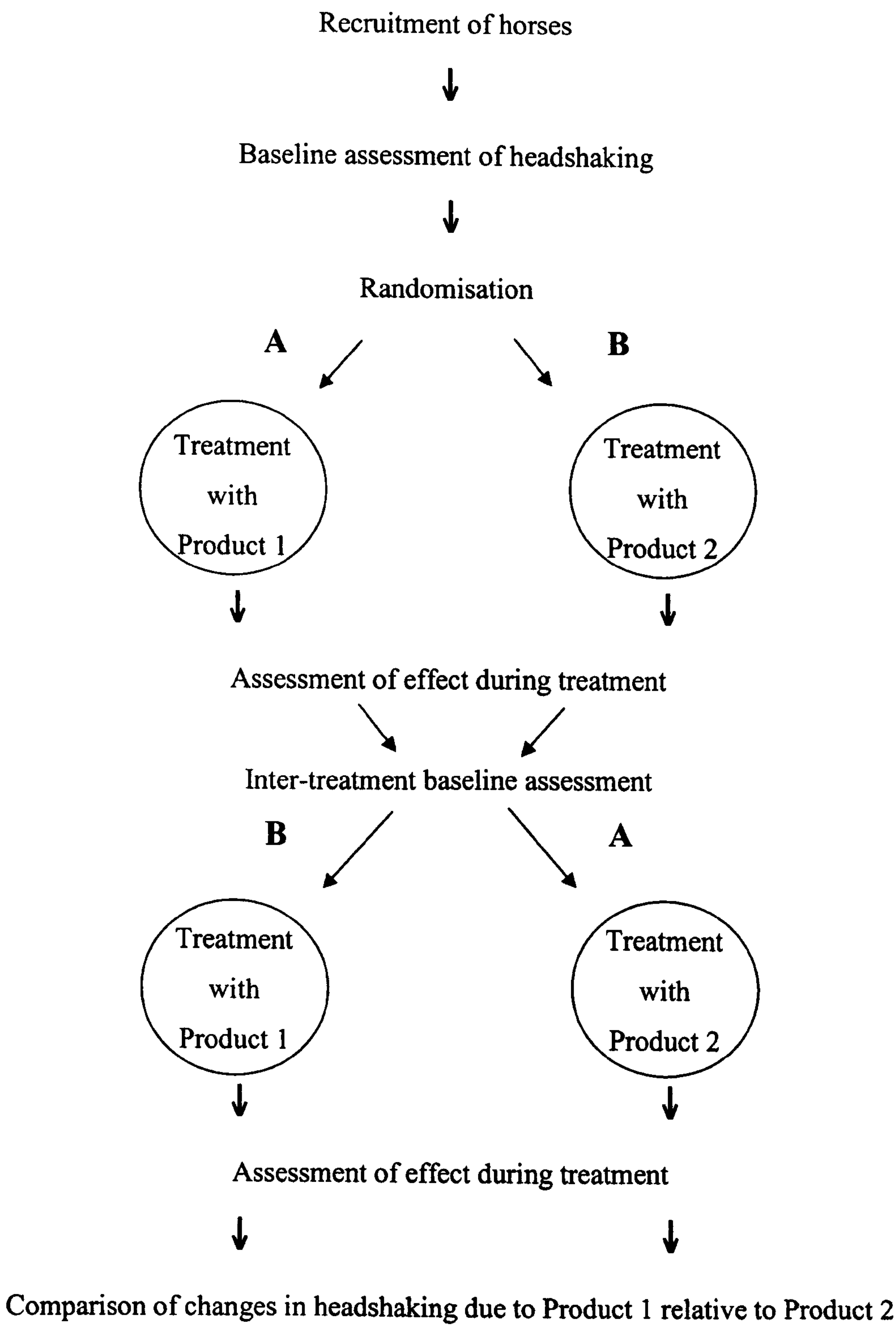

Fig. 9.1. Design and procedure used for the cross over trials

9.5 Timing and length of trial

The reported seasonal nature of the headshaking problem has an impact on the timing and length of any study assessing the efficacy of treatment. Authors have frequently reported that about two-thirds of their sample of headshakers suffered only in the spring-early autumn time (Mills *et al.* 2002a, Lane and Mair 1987, Madigan and Bell 2001 and Chapter 3). As a result any trial could effectively be conducted only during the summer months. Trials extending any longer than this might become adversely affected by changes to the horse's headshaking severity either at the start of the season, when symptoms are becoming more severe, or towards the end of the season when their severity decreases as part of the horse's usual seasonal pattern. Figs. 3.2 and 3.3 illustrate this. The length of time for which each management aid was assessed was decided upon after consideration of several factors. The most important was the length of time that the aid in question was expected to require before a noticeable change in the animal's behaviour could reliably be observed. Once a minimum time-frame was established, the actual length of time for which each horse tested the management aid was a trade off between establishing a reliable measure, ensuring that any improvement was sustained and owner compliance. The latter is a pertinent factor if the treatment is a placebo or its expected efficacy is unknown. Repeated observations were necessary to ensure that the observed effect was related to the treatment rather than the expected variation in headshaking severity from one day to the next or from one riding environment to another (see Chapter 8), and as such the length of the trial had to accommodate this.

Since the face mask and bitless bridle were both reported to have an almost immediate effect on the horse's symptoms (Eby pers. comm., Cook 1998a) an assessment of the effect of treatment could, in theory, immediately follow a baseline assessment. However, for several reasons this was not considered appropriate. Firstly, the headshaking is usually reported to deteriorate as exercise progresses (67% of owners reported this in the most recent survey, see Section 3.4.8). Allowing the horse some time to begin headshaking, making a baseline assessment, and then applying the management aid might not only have proved difficult but might result in no visible change to the headshaking, simply because the attack had already been precipitated and the horse become too agitated. Secondly, the ability of the aid to *prevent* headshaking signs could not have been tested it this way. Thirdly, some time was required for both horse and owner to become accustomed to fitting and then riding in the face mask or bridle in order to properly assess their efficacy.

In conclusion, a 2-week period in which to assess the effect of the treatment, following a 1-week baseline assessment, was chosen to not only cover for day-to-day variation unrelated to the treatment but also to establish the extent of any sustained improvement when wearing the bridle or face mask. Two weeks also seemed a reasonable amount of time to ask the owner to persist with something that might appear ineffective but that significantly impacts on the management and use of their horse. For the magnetic headcollar a two-week period was also considered a reasonable length of time to establish likely efficacy (McClenaghan pers. comm.). However, the herbal supplement required a longer time-frame (Leer pers comm.) and changes to the trial procedure as a result of this are described in Chapter 12 which presents the results of this trial. The length of each of the four trials is illustrated in Table 9.1.

9.6 Recruitment of subjects

9.6.1 Interest in the trials

Horse owners on the NEHS database were contacted in February 2001 with regard to their interest in participating in field studies of the three devices (the herbal supplement trial was not offered at this time). 54% of owners (89 out of 164 contacted) returned the form expressing a willingness to participate in at least one of the proposed trials. Interest was highest towards the bitless bridle and face mask with 77 and 76 (87% and 85%) of owners expressing a willingness to participate in their assessment, respectively. Interest was lower for the magnetic headcollar, with 64 owners (72%) indicating a willingness to participate in a trial. Overall, 49 owners (55%) were prepared to participate in all three proposed trials.

Table 9.1. The length of each trial and the occurrence of written assessment within each trial at the end of the specified week (horses were monitored throughout the trial). B indicates a baseline assessment, T indicates a treatment assessment. Shaded cells indicate when the first treatment was applied to the horse; darker shaded cells indicate when the second treatment (if applicable) was applied. For the supplement trial, assessments were made every week of the trial, but only those marked in the table were used in the final assessment. Bold vertical lines indicate the end of the trial.

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Bitless bridle Chapter 10	B		T											
Face mask Chapter 11	B		T											
Headcollar Chapter 12	B		T	B		T								
Supplement Chapter 13		B					T		B					T

9.6.2 Selection criteria

Subjects for each trial were chosen at random without any formal probabilistic design from those owners who had indicated an interest in the trial in question and where the horse satisfied the following inclusion and exclusion criteria:

9.6.2.1. Inclusion criteria

- The owner believed that their horse had a headshaking problem which manifests itself as apparently involuntary shaking of the head, primarily when ridden
- The owner had completed the survey described in Chapters 3–5 (Q2000) as part of the National Equine Headshaking Survey, giving detailed information regarding their horse
- The horse was reported in the above survey to exhibit 'when being ridden' at least one of the following clinical signs: *headshake* (vertical, horizontal or rotary), *flipping the nose/top lip* or *twitch* (the nose or muzzle)
- The owner had experienced the headshaking problem in their horse for at least one season prior to the trial
- At commencement of the trial the horse was reported to be exhibiting headshaking symptoms
- The occurrence and severity of the horse's symptoms were not expected to change over the course of the trial in accordance with their usual headshaking pattern
- The owner had completed an informed consent form for each trial (Appendix VIII)

9.6.2.2 Exclusion criteria

- Immature horses (less than 5 years old), not fully broken to ride
- Horses that were not regularly exercised
- Owners and/or horses that had had previous experience with the management aid in question
- Horses that had begun new conventional or non-conventional (i.e. herbal, homeopathic) treatments for headshaking within 2 months of the start of the trial

9.6.3 The basic characteristics of the horses in each study

A list of the horses included in each trial is given in Appendix VI. This provides their sex, year of birth, year of onset of the headshaking, seasonal pattern to the headshaking, use, breed and which of the four trials they actually participated in. A number of horses participated in more than one trial. In addition, the summary statistics of a range of characteristics of the horses recruited was presented for each trial. These were:

- Sex (stallion, gelding or mare)
- Breed type (thoroughbred, cob, pony, warmblood or other)
- Age (at time of the trial to the nearest 0.25 year)
- Use (pleasure or affiliated/professional competition only)
- Seasonality of the headshaking (sunny seasonal, perennial with sunny seasonal exacerbations, perennial or other)
- Severity rating of the headshaking (barely noticeable, bearable, unpleasant or unrideable)
- Length of time known to be headshaking (at time of the trial to the nearest 0.25 year)

All of the above details were obtained from the completed Q2000 survey and adjustments were made where applicable to allow for the time elapsed since its completion. For the two placebo-controlled trials a comparison was made of the horse details between the two allocation groups (i.e. those that received product first and those that received placebo first). Fisher's exact test (SAS v 8.0, SAS Institute, Inc) was used to assess the significance of the difference in proportions of horses in each of the categories between the two allocation groups for sex, breed (thoroughbred or not), use, seasonality (sunny seasonal or not) and severity score (worse than bearable or not). The Wilcoxon rank-sum test was used to assess the significance of the difference in median age and length of time known to be headshaking between the two allocation groups.

9.6.4 Number of subjects required per trial

The 'power' of a statistical test, i.e. the degree of certainty that the size of change from baseline, if present, would be detected, increases with the number of subjects involved in the study (Pocock 1991). If the number of subjects is low the risk of a false negative result increases (i.e. the risk that a significant difference is not detected when it is really present, also known as a type II error). As a convention, studies aim to recruit enough subjects to obtain a power (probability) of 90% that a specified difference would be detected as significant. However, the number of subjects that are required for a study given this level of power depends on the expected size and variation of the change from baseline after treatment. This information is usually obtained from phase II safety and efficacy trials or trials of similar treatments. Since there have been no phase II trials for the management aids described here, an estimation of the effect size was taken from the results from the trial of the nose net (Mills and Taylor 2003) and also the manufacturers' expectations. The effect size was generated using:

Effect size=mean (baseline)-mean (treatment)/standard deviation

(By convention an effect size of 0.2=small, 0.5=medium and 0.8=large effect, (Cohen 1988))

In the nose net trial the mean (SD) overall severity score at baseline was 3.58 (0.91) and 2.35 (1.15) when using the half net. The effect size, using an average of the standard deviations (1.03), was therefore 1.19 (a large effect). The power of the trial to detect this effect size given the sample size of 36 horses was 0.9996 (two-tailed), calculated using G*Power v 2.0 (Faul and Erdfelder 1992). This effect size was generated by the horses improving by only one point on average on the five point scale used. Assuming a similar level of improvement in the planned trials, an effect size of 1 would require 23 horses to achieve a power of 90%. A sample size of at least 20 horses was therefore sought for each trial. The actual power of each study to detect the estimated size of effect given the number of animals participating was calculated post hoc for each trial, using G*Power v 2.0 (Faul and Erdfelder 1992), on the measure *overall severity* (two-tailed outcome).

9.7 Choice of headshaking signs to be assessed

Most authors reporting response to treatment for headshaking did not provide which measures they used to estimate the effect of treatment for headshaking. Newton *et al.* (2000) reported only using frequency of headshakes in 2-minute periods to assess improvement but did not report the results from these. Since other signs, such as nasal rubbing and snorting usually feature significantly in the syndrome, for completeness, a range of signs should be measured in addition to the headshaking. Asking the owner to assess a range of behaviours also helps focus the assessor's attention on the presentation of the condition so that some kind of general measure, overall severity, for example, is more likely to be representative. The choice of signs to include therefore involved some compromise between their significance (i.e. reported prevalence in the sample), the reliability of the reports of their occurrence and avoidance of unnecessarily increasing the risk of type I errors. The use of multiple outcomes in trials is usually not recommended since this increases the likelihood that a significant change will be found by chance alone (type I error) especially when the outcomes are inter-related (Pocock 1991). However, pooling the scores for each sign for each horse to make a 'total headshaking score' was not feasible since not all horses exhibit all signs. It is also possible that a treatment has a differential effect on each sign and this needed to be accounted for. One solution was therefore to limit the number of outcomes as much as possible and then to define *a priori* measures of primary importance (Pocock 1991).

For these trials the owner's assessment of *vertical headshaking* (and *overall severity*) was chosen as the primary measure and other signs were included as secondary to identify general patterns but were not treated as further evidence of effect. Signs were therefore chosen from those that had been reported in the Q2000 with a prevalence of over 30% and had achieved over 75% average agreement both within owners, amongst a sample of owners and between the owner and an independent assessor, as described in previous chapters. These are summarised in Table 9.2. The reported prevalence of some of the signs in the exercises was low (less than 30%) so the percentage agreement for these may not be accurate.

Table 9.2. The headshaking signs chosen for assessment in the trials, their reported prevalence in the Q2000 survey and the average percentage intra-owner, inter-owner and owner-independent assessor agreement, see chapters for full details. Percentages in parentheses refer to average percentage agreements regarding signs that were reported in less than 30% of the horses under assessment.

Behavioural sign	**% prevalence (Chap 5)**	**% Intra-owner agreement (Chap 6)**	**% Inter-owner agreement (Chap 6)**	**% Owner-independent agreement (Chap 8)**
Vertical headshaking	93%	84%	77%	92%
Snorting or sneezing	82%/61%	87%	86%	92%
Dropping nose to ground	55%	92%	87%	92%
Rubbing nose on objects	81%	(94%)	(84%)	(100%)
Rubbing nose on foreleg	82%	(94%)	(95%)	(83%)
Striking at nose	55%	N/A	(90%)	(75%)
Flipping nose/top lip	48%	85%	76%	75%

9.8 Assessment procedure

9.8.1 Instructions to owners

The owners were asked to assess their horse's headshaking at exercise (ridden or lunged) for the purposes of the trial at least once each week during the length of the trial. During this assessment they were asked not to use any other device, such as a nose net, to control the headshaking and to walk the horse for the first 5 minutes before beginning to trot. A baseline assessment form was then completed regarding one week prior to testing each device and a treatment assessment during the last week only of the treatment period. Since a single assessment was considered to be unreliable, it was anticipated that the owner would make several assessments each week. Rather than asking them to record each assessment, the form asked them to record the severity and occurrence of the headshaking for a 'typical' assessment during that week. Recording each assessment would result in more paperwork for the owner, which might erode their commitment to the trial. It was also felt that the owner's assessment of the horse's average behaviour would more closely reflect reality than a mathematical average of multiple assessments. The extent to which the owners felt that they had to 'average' out assessments when completing the form was covered by a question relating to the day to day variability of the horse's headshaking that week.

The baseline and treatment assessment forms were identical and covered various aspects of the horse's headshaking during typical exercise that week. They also asked how many times the horse had been assessed for the purposes of the trial that week, whether the horse was lunged or ridden and how long it took on average before the horse began to headshake during these assessments. Owners were instructed to return the baseline assessment form as soon as it was completed, so they would not be able to refer to it when completing the treatment assessment form and when making their judgment about the efficacy of the device in question.

Several owners, who were not able to take part in the trials, piloted the assessment form. They gave feedback regarding their understanding of each of the questions and the ease with which the questionnaire could be completed. Some small changes were made to the final assessment form as a result. Appendix IX provides a copy of the treatment assessment form.

9.8.2 Design of the assessment form

9.8.2.1 Assessing the frequency, severity and occurrence of headshaking signs

As owners were being relied upon to assess the change in their horse, any measure must be simple for the owner to understand and use. However, more than a simple scale for improvement (partial, substantial, complete, etc) was necessary since information was required on the manner by which the horse may have improved and its relationship to some baseline measurement. There are three ways in which the headshaking signs in a horse may change over the course of an assessment:

- Change in the severity of the sign, e.g. in the extent of the movement in the headshake
- Change in the frequency of the occurrence of the sign *during* an attack, e.g. the number of headshakes per minute
- Change in the frequency of attacks, i.e. the likelihood of the horse having a headshaking attack at any given time

It cannot be assumed that these three measures are interdependent. It is entirely possible that during treatment a horse may shake its head with the same ferocity as usual but this occurs less often, so that the owner feels the treatment is helpful. Therefore each of these three measures needs to be accounted for in any assessment.

Asking the owners to count the number of headshakes, etc., was considered inappropriate, since the owner is usually riding the horse at the time of assessment and the experience may be stressful. It can also be particularly difficult to distinguish individual headshakes from a 'bout' of headshakes, especially if the head movement consists of rapid flicks or nods. A scale was therefore developed in an attempt to generate a real measure of the extent of the headshaking problem, rather than an abstract score. For each of the seven headshaking signs the owners were asked to mark anywhere on the 7-point Likert-like scale below the frequency of occurrence of the sign during a typical ride:

Vertical headshaking	|	|	|	| ×	|	|	|
	never		occasionally		frequently		continually

The marks placed by the owners on the sliding scale for each headshaking sign were converted into numerical values by counting the number of divisions before the mark, from the far left (0) to the far right (6). The distance from the division and the mark was then measured out of 10 to give a final score for the mark to 1 d.p, in order to measure more accurately the owner's marks. The mark on the scale above, for example, would score 3.5. This method of marking on a sliding scale was chosen in an attempt to encourage the owners to make a genuine assessment of the frequency of the occurrence of the sign, as opposed to generalising the severity of their horse's problem into a score.

The severity of the headshaking problem in general was assessed by asking owners to rate the *overall severity* of the headshaking signs and the size of movement in the headshake on a similar 7-point scale to that above, marked with; 'none', 'quite mild', 'quite severe' and 'very severe' (overall severity) and 'none', 'small', 'large' and 'very large' (size). The marks on the scales for these two measures were evaluated as described above.

In order to measure the likelihood of headshaking occurring during the course of the trial, specific situations were listed and the owner asked to rate the likelihood of headshaking occurring under these during the assessment. These were chosen from situations listed in the Q2000 survey that had been reported as tending to increase, not affect or decrease the likelihood of headshaking occurring, see Section 3.4.8. These were *when excited, in bright sunlight, in the rain, in the wind, at rest* and *in trigger* *spots*. The latter situation was created to encompass the belief amongst many owners that certain locations tend to exacerbate the condition, such as wooded areas or around certain flowering crops. Since increased subtlety was not required in this case, rather than a sliding scale as for the signs, the owners were asked to rate the likelihood of the headshaking occurring (from 0, very unlikely to 6, very likely) in each of the listed situations, for e.g.:

How would you rate the likelihood of headshaking occurring when your horse was...;

	very unlikely			hard to say			very likely	
Excited	0	1	2	3	4	5	6	N/A

If the condition was not experienced this week, please circle N/A
If your horse does not shake in the condition, please circle 1 (very unlikely)

The owners were also asked to rate the day-to-day variability of the headshaking, on a similar scale to that above labelled with 'very inconsistent' to 'hard to say' to 'very consistent'.

9.9.2.2 Assessing owner perception of the treatment

On the treatment assessment form the owners were asked to rate the management aid for its effectiveness in alleviating headshaking on the 6-point scale shown below:

How would you rate the device for alleviating your horse's headshaking symptoms?

1	2	3	4	5	6
Totally Ineffective	Hard To Tell	Slightly Effective	Partially Effective	Very Effective	Extremely Effective

Owners were also asked how satisfied with the management aid they were, since this is another measure of its success. For this the same scale as above was used, with labels; 'dissatisfied', 'hard to say', 'slightly satisfied', 'quite satisfied', 'very satisfied' and 'extremely satisfied'. The scores for 'efficacy' and 'satisfaction' were retained as scores from 1–6 and the average score and the percentage of horses that fell into each category was presented. Finally, the owners were asked if they had observed any other changes in their horse since using the device, when they observed these changes and to make any other comments regarding the device on the reverse of the form.

9.9 Measuring change

9.9.1 Treatment-baseline differences

Each headshaking measure was analysed separately. Missing values or N/As were omitted from each analysis, as such comparisons between baseline and treatment could not be made for that measure for that horse. For each of the headshaking signs, horses with a score of zero at baseline were also omitted, since these horses did not normally show that sign as part of their headshaking problem. If these horses had been included it would have skewed the data towards no change for that measure (a zero for both baseline and treatment) or deterioration in that measure. The median score at baseline for each measure was calculated and the number of horses (*N*) that were included in this was also presented.

For each of the headshaking measures the outcome was defined as:

$$\textbf{Outcome, } d = t - b$$

Where, t=treatment score, b=baseline score

To test whether each outcome measure differed significantly from zero, the Wilcoxon signed rank test was used. This non-parametric statistical test was used since the outcomes were recorded on an ordinal scale, for example, a horse with a score of 6 may not necessarily be twice as severe as a horse with a score of 3. The sample size, *N*, for the test constituted the final number of observations used in the test because Wilcoxon tests ignore differences of zero. In all cases a p-value < 0.05 was considered significant evidence for a difference and $0.05<p<0.1$ was considered a noteworthy tendency. The test statistic, *Z*, represents the normal approximation to the median outcome measure.

When assessing the effect of a treatment, it is important to report not only the significance of treatment-baseline difference, but its size (Martin and Bateson 1993). Even if the difference from baseline in a given headshaking measure was found to be significantly different from zero, this would not necessarily indicate an effective treatment if the size of this difference was very small. The percentage of horses improving by a predefined amount from their own baseline is useful to report, (for example, 40% of horses improved by at least 50% from their baseline score). This method was used in the assessment of the nose nets by Mills and Taylor (2003).

The percentage change from baseline was calculated by:

$$\textbf{Percentage improvement from baseline} = (1 - (t / b)) \times 100\%$$

Where, t=treatment score, b=baseline score

Example:

A horse with a score of 4.0 for *vertical headshaking* at baseline and of 2.0 during treatment would have an outcome measure of $2.0 - 4.0 = -2.0$. This represents an improvement of 2.0 on the scale.

The percentage improvement would be $(1-(2.0/4.0)) \times 100\% = 50\%$ better

For each measure, horses were judged to have 'improved' if the percentage improvement was 10% or more. The number and percentage out of the total number of horses for which the outcome was greater or equal to 10% was therefore presented in addition to those with at least 50% improvement.

9.9.2 Within-horse differences (cross-over trials only)

In order to evaluate the change in score from baseline (the outcome, d, see 9.10) for verum over placebo, the difference between each of the outcome measures for the verum and placebo was calculated for each horse, as shown below:

Within—horse difference, $w = d(\text{verum}) - d(\text{placebo})$

Where, d(verum)=outcome under verum treatment (i.e. treatment–baseline score, see 9.10) and d (placebo)=outcome under placebo treatment.

Example:
A horse has a treatment–baseline difference for *vertical headshaking* with the product of –2.5 and a treatment–baseline difference of –1.7 with placebo. The within-horse difference for this horse, for the sign *vertical headshaking*, would be $-2.5 - -1.7 = -0.8$. This means that there was a greater reduction in the occurrence of this sign with the verum than with the placebo.

The Wilcoxon signed-rank test was used to assess whether the within-horse difference was significantly different from zero. (In addition, the Wilcoxon signed-rank test was used to assess the significance of any difference between baseline assessments in headshaking scores prior to each of the two treatment types. Significant differences between baselines might explain any lack of difference in outcomes between the treatments.)

9.9.3 Additional statistical tests

The average score for variability and number of assessments made was averaged across both baseline and treatment assessments. The difference between treatment and baseline assessments in these two measures was assessed using the Wilcoxon signed-rank test. For the headcollar trial, the difference between day to day variability of the headshaking, efficacy and satisfaction rating of the treatment and number of assessments during the treatment assessment was also compared between verum and placebo in the same manner. For the herbal supplement trial only the latter measure was compared between treatment assessments. The number of horses that were reported to increase, change or decrease in their latency to headshake from baseline to treatment assessment was presented. For the headcollar trial the difference in this change between verum and placebo was compared using the Wilcoxon signed-rank test.

9.10 Summary

A protocol for the assessment of the effect of a range of management aids on the reported signs of equine headshaking has been described. The method of the assessment of the efficacy of the face mask and the bitless bridle was similar to a safety and efficacy trial. A placebo-controlled, cross-over trial was designed to assess the effects of a magnetic headcollar and an herbal supplement on headshaking signs. The use of owners as the assessors of their horse's response to the management aid in question was preferred on the basis of their demonstrated consistency in reporting the presence of signs in a video trial and other evidence to support the contention that the horse's headshaking would be more reliably observed in its home environment over several occasions.

The range of signs observed in the horses and the different ways in which the headshaking can be measured had to be accommodated in the owners' assessment at the end of every treatment period. Seven-point scales were created to measure the frequency of the occurrence of each sign within a typical ride, the overall severity and size of headshake and the likelihood of the attacks occurring in certain situations. Change in the frequency of *vertical headshaking* and in *overall severity* were chosen *a priori* as measures of primary importance, with the remaining measures providing information on the manner in which the treatment in question produced an effect, if any.

Chapter 10

Part IV

Assessment of management aids for equine headshaking syndrome:

1. A field trial of a bitless bridle

(Results published as; Taylor *et al.* 2003)

10.1 Introduction

In the veterinary literature it has been speculated that the use of the bit is a potential cause of headshaking in horses (Cook 1998a). This might operate in a number of ways. Firstly, coercing the horse's neck into an acute angle by use of the bit might interfere with breathing. Horses might be responding to this partial asphyxiation by throwing their heads in order to improve airflow (Cook 1992). Secondly, placing something in a horse's mouth and then asking it to exercise might be both physiologically and psychologically confusing for the horse, as an obligate nose breather, and perhaps result in them shaking their head in frustration (Cook 1998a). Thirdly, the presence and use of the bit might also cause pain (Cook 1999, 2000, 2002, 2003). Reaction to 'bit-induced pain' might provide a direct mechanism for the cause of headshaking syndrome in horses (Cook 2000, 2003). Pressure of the bit on the bars of the mouth or against the teeth might set up neuralgia in the mandibular branch of the trigeminal nerve, which is then referred to the maxillary branch of the nerve (Cook 1999), see Fig. 1.1 for illustration. Trigeminal neuralgia has long been associated with headshaking (Williams 1897, Cook, 19801, Madigan *et al.* 1995, Newton *et al.* 2000) but a likely cause in the horse has remained largely unknown. Cook's hypothesis provides not only an explanation for the cause of the neuralgia and a mechanism for the presentation of the signs of naso-facial irritation, but also suggests a potential treatment–not using a bit during exercise. Cook recommends a specific form of bitless bridle that could be used in disciplines where the use of the bit is not mandatory–the bitless bridle ™ (Cook 1998a).

The design of the Bitless Bridle ™ is based on a system of two loops; one over the poll and one over the nose (see Fig. 10.1). Although an extension of each rein crosses to the opposite side of the head, under the horse's chin, the hand aids are the same as for traditional English riding. Transient traction on one rein (the white arrow in Fig. 10.1) produces pressure to the poll and the whole contralateral side of the head (the black arrows in Fig. 10.1). The horse is encouraged to turn away from this pressure, thus providing the mechanism for turning. In order to slow and stop the horse, pressure on both reins applies a 'squeeze' to the whole of the head. Unlike the mechanics of the bit, turning and stopping is not dependant on focal, potentially painful, pressure on the lips, tongue or bars of the mouth, or, in the case of other types of bitless bridles, on the bridle of the nose or poll (Cook 1999).

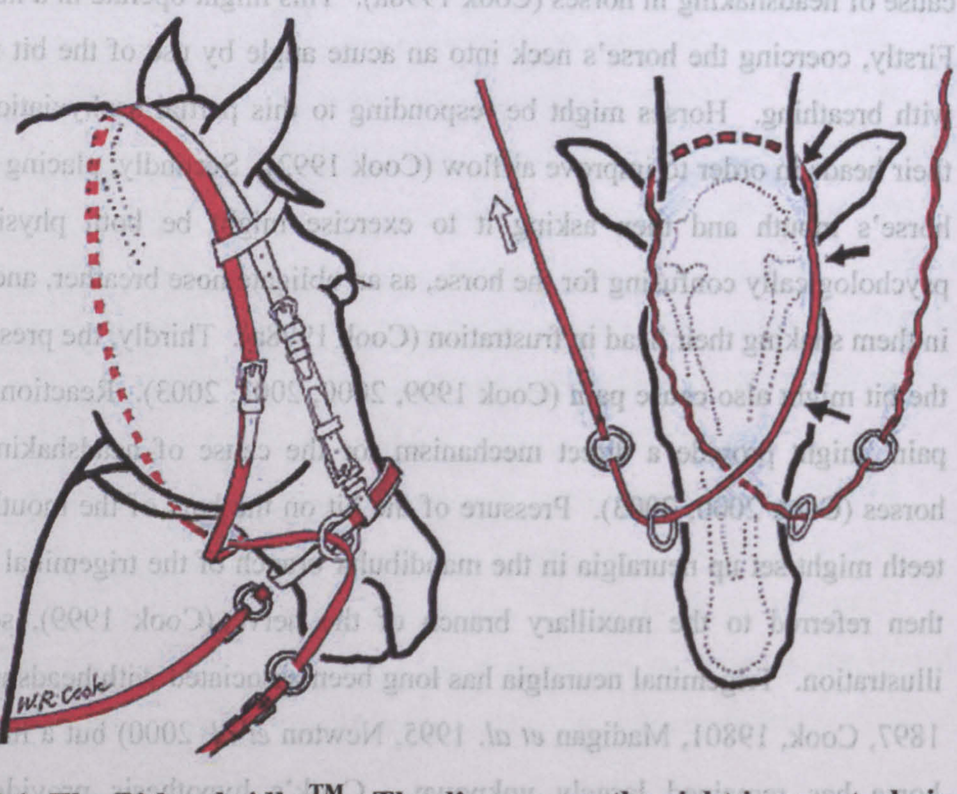

Fig. 10.1. The Bitless bridle ™. The diagram on the right is a ventral view of the horse's head. (reproduced from Cook 1999)

Cook initially reported upon three headshakers that ceased headshaking when ridden in the bridle (Cook 1998a). In a more recent paper, Cook reported the cessation of head-shaking or tossing in 46 horses when their owner began to use the bitless bridle (Cook 2003). Despite the plausibility of this theory, however, there have been no systematic studies reported on the effect of the bitless bridle on headshaking symptoms.

10.2 Aim

The aim of the study was to test the hypothesis that use of a bitless bridle over a short period of time would reduce the occurrence and severity of headshaking signs in a selection of horses considered by their owners to have a headshaking problem.

10.3 Trial method

The trial was designed as a simple efficacy and safety field evaluation. Interested owners were asked to complete a baseline assessment of the occurrence and severity of their horse's headshaking problem, during ridden work, as described in Section 9.8, for one week. During this time a bridle was sent to the owner. Full instructions as to the fitting and use of the bridle was included in the form of the Bitless bridle ™ User's Guide (Cook, 1998b). The owners were asked to assess their horse's headshaking behaviour for a period of two weeks when the horse was ridden in the bridle (and no other device to control the headshaking). An identical treatment assessment form regarding the horse's behaviour during ridden exercise in the bridle was completed for the latter of the two weeks. This was then returned to the researcher, together with the bridle, unless an agreement to purchase it at a reduced price had been made.

Measures of primary importance were change in the occurrence of *vertical headshaking* during the course of a typical ride, assessed on a sliding 0–6 scale and change in *overall severity* assessed on a similar scale. Secondary measures included change in six other headshaking signs, size of the headshake and likelihood of headshaking occurring in six situations. See Chapter 9 for details of the trial organisation and assessment, and Appendix IX for a copy of the assessment form.

Recruitment of horses onto the trial started on 1st May 2001 and ceased on 30th September 2001. A total of 20 bridles (4 large, 14 medium and 2 small) were available for the purposes of the trial. Allocation to the trial was made at random, without a probabilistic design, although start dates did depend on the availability of the horse, its owner and a bridle of the correct size.

10.4 Follow-up, one year later

In order to evaluate whether long-term use of the bridle had an effect on the headshaking, a follow-up survey of all trial participants was conducted one year later. In July 2002, all participants were contacted via telephone and asked whether in general their horse's headshaking problem had improved, stayed the same or deteriorated since the previous year. Owners who had opted to purchase the bridle were asked whether they continued to use the bridle 'continually', 'regularly', 'occasionally' or 'never' since the trial. They were also asked if they felt their horse's headshaking had 'improved', 'deteriorated' or 'stayed the same' since the trial.

10.5 Results

10.5.1 Basic characteristics of horses in the trial

A total of 29 horses participated in the trial of the bitless bridle, although completed records were only available from 27. Table 10.1 lists the basic characteristics of the horses participating in the trial. A range of breeds and ages were represented. Most horses were geldings, were used primarily for pleasure and had had the problem for several years. 76% of the horses had a headshaking problem that the owner considered to be at least 'unpleasant' when at its worst. Most horses (93%) had a sunny seasonal component to their problem, although 41% were reported to suffer to some extent all year round. Owners were also asked what kind of bridle they usually rode their horse in prior to the trial; 19 (66%) reported that they used a snaffle bit, 3 a gag bit, 3 a Pelham and 2 a double bridle, although 4 of these latter two groups also reported the use of a snaffle at other times. Only 2 owners reported that they normally rode in a bitless bridle (a German hackamore).

10.5.2 Conditions during the course of the trial

Throughout the trial, the horses were exercised for the purpose of assessment 3.5 occasions each week on average (SD 1.53, median 3, range 1–7, $N = 54$). However, there was a tendency for the owners to ride the horse *more* during the treatment assessment (i.e. with the bitless bridle) than during the baseline period (mean difference +0.48, SD. 1.25, median 0, Wilcoxon signed-rank test; $Z = 1.89$, $N = 18$ for test, $p = 0.058$).

Throughout the trial, the variability score of the headshaking was rated as 3.6 on average (SD 1.79, median 3, range 0–6, $N = 53$) which suggests that the headshaking varied between being consistent and inconsistent, i.e. 'hard to say'. There was no significant difference in variability score between baseline and treatment assessments (mean difference 0.08, SD 2.00, median 0.5, Wilcoxon signed rank test; $Z = 0.36$, $N = 22$, $p = 0.719$).

Table 10.1. The basic characteristics of the horses participating in the trial of bitless bridle.

Characteristic	Trial participants
Number of horses	29 (complete records available for 27)
Sex	20 geldings (69%), 9 mares
Breed type	3 thoroughbreds, 9 cobs, 7 ponies, 10 others, no warmbloods
Use	21 primarily pleasure 8 affiliated/professional competition
Age	Mean 11.75 years, SD 4 years Median 11 years, Range 4.5–20 years old
Seasonality of headshaking	15 sunny seasonal 12 perennial with seasonal exacerbations 2 unusual or unknown pattern
Severity rating of headshaking	0 (barely noticeable), 7 (bearable) 14 (unpleasant), 8 (unrideable)
Known to be headshaking for (to nearest ¼ year)	Mean 5.25 years , SD. 3.25 years Median 4.5 years, Range 1–15 years

10.5.3 Treatment–baseline difference in headshaking

There was a statistically significant improvement from baseline in *overall severity* ($p = 0.026$) although the median size of this difference was small, 0.3 on a scale that ranged from 0–6, see Table 10.2. There was no significant difference in frequency of *vertical headshaking* when using the bridle ($p = 0.341$).

Table 10.2. The median scores for *overall severity* and frequency of *vertical headshaking* at baseline (out of *N* horses with a score) and the median treatment–baseline difference, *d*. Also shown are the results of Wilcoxon signed-rank tests of the significance of the difference of d from zero for each measure (Test statistic, *Z*, *N* for test (differences of zero are ignored) and p-value).

Measure	*N*	Median baseline score	Median change, *d*	*Z*, test statistic	*N* for test	P-value
Overall severity	27	3.5	–0.3	–2.22	22	0.026
Vertical headshaking	27	3.5	0.0	–0.95	23	0.341

There was a statistically significant improvement in 5 of the 14 other headshaking measures, tendency to headshake *in trigger spots* ($p = 0.006$), tendency to headshake *in bright sunlight* ($p = 0.018$), *flipping the nose/top lip* ($p = 0.035$), tendency to headshake *in the wind* ($p = 0.049$) and *size of headshake* ($p = 0.028$), see Table 10.3. There was also a trend for improvement in frequency of *horizontal headshaking* ($p = 0.052$). With the exception of *horizontal headshaking* ($d = -0.4$), *size of headshake* ($d = -0.2$) and *flipping the nose/top lip* ($d = -0.2$), the actual median improvement from baseline, *d*, was zero.

Table 10.3. The median score for each headshaking measure at baseline (out of *N* horses with a score) and the median treatment–baseline difference, *d*. Also shown are results of Wilcoxon signed-rank tests of the significance of the median difference of d from zero for each measure (Test statistic, *Z*, *N* for test and p-value).

Measure	*N*	Median baseline score	Median change, *d*	*Z*, test statistic	*N* for test	P-value
Snorting or sneezing	26	3.3	–0.1	–0.88	21	0.379
Dropping nose to ground	19	1.5	–0.1	–1.30	15	0.195
Rubbing nose on objects	22	2.2	–0.1	–0.88	18	0.379
Rubbing nose on foreleg	22	1.8	–0.3	–1.06	20	0.291
Striking at nose	21	0.8	0.0	+0.18	15	0.860
Flipping nose/top lip	21	3.0	–0.2	–2.11	18	0.035
Likelihood of headshaking when:						
Excited	18	4.5	0.0	–0.99	9	0.323
In bright sunlight	24	6.0	0.0	–2.37	9	0.018
In the rain	19	1.0	0.0	+1.38	8	0.168
In the wind	20	4.0	0.0	–1.97	7	0.049
At rest	23	0.0	0.0	–0.64	6	0.525
In trigger spots	26	6.0	0.0	–2.75	11	0.006
Size of headshake	27	3.5	–0.2	–2.19	23	0.028

10.5.4 Percentage improvement from baseline

For the measures of primary importance, more horses were reported to have improved from baseline when riding in the bridle than were reported to have worsened, see Table 10.4. However, for each measure, a large proportion of horses were reported not to have changed by 10%. 19% of horses were reported to have improved by at least 50% of their baseline score in *overall severity* and 22% in frequency of *vertical headshaking.*

Table 10.4. The number of horses (out of *N* with a score at baseline) that were reported to have deteriorated or improved from their baseline score by at least 10%, for *overall severity* and frequency of *vertical headshaking* when being ridden in the bridle. Also shown is the percentage of horses (out of *N*) that were reported to have improved by 50% or more from their baseline score.

Measure	*N*	Worse 10%+	No change	Improved 10%+	Improved 50% +
Overall severity	27	5	8	14	5 (19%)
Vertical headshaking	27	10	6	11	6 (22%)

For the secondary signs, 39% of horses (9 out of 23 reported with the behaviour at baseline) were reported to have improved by 50% or more in frequency of *horizontal headshaking* when using the bridle, see Table 10.5. 32% were reported to have improved by 50% or more in frequency of *dropping the nose to the ground* and *rubbing the nose on objects*, 29% in *flipping the nose/top lip* and 27% in *rubbing the nose on the foreleg.* The percentage of horses reported to have improved by at least 50% in their tendency to headshake in certain environmental situations was lower than the improvement recorded for the behavioural signs in general. The highest percentage of horses reported to improve by 50% or more was reported for the tendency to headshake *in the wind* (15%). None of the horses were reported to have improved by 50% in their tendency to headshake *in the rain*.

Table 10.5. The number of horses (out of *N* with a score at baseline) that were reported to have deteriorated or improved by at least 10% when wearing the bridle, for each headshaking measure. Also shown is the percentage of horses (out of *N*) that were reported to have improved by 50% or more of their baseline score.

Measure	*N*	Worse 10%+	No change	Improved 10%+	Improved 50% +
Snorting or sneezing	26	7	8	11	3 (12%)
Dropping nose to ground	19	3	6	10	6 (32%)
Rubbing nose on objects	22	6	5	11	7 (32%)
Rubbing nose on foreleg	22	7	3	12	6 (27%)
Striking at nose	21	7	7	7	3 (14%)
Flipping nose/top lip	21	4	7	10	6 (29%)
Likelihood of headshaking when:					
Excited	18	3	9	6	1 (6%)
In bright sunlight	24	1	15	8	2 (8%)
In the rain	19	6	11	2	0 (0%)
In the wind	20	1	13	6	3 (15%)
At rest	23	2	17	4	3 (13%)
In trigger spots	26	1	15	10	2 (8%)
Size of headshake	27	4	11	12	3 (11%)

10.5.5 Other measures of potential efficacy

10.5.5.1 Latency to headshake

In the baseline assessment, only one horse began to headshake immediately upon exercise. 21 horses (78%) did not begin to headshake until after they were asked to trot (5 minutes) and 10 of these (37% of the total) until at least 10 minutes into exercise. During the treatment assessment, 9 (33%) horses increased, 12 did not change (44%) and 6 (22%) reportedly decreased in their latency to headshake, i.e. worsened.

10.5.5.2 Efficacy rating

The mean efficacy rating of the bitless bridle as rated by the owners was 2.25 on a scale of 1 to 6 (SD 1.45, median 2, range 1–6, N = 27). The median score equates to an efficacy rating of 'hard to tell' (see Appendix IX for the efficacy scale in the assessment form). 9 owners rated the bridle as 'totally ineffective', 9 reported it to be 'hard to tell', 3 reported that it was 'slightly effective', 3 that it was 'partially effective', 2 that it was 'very effective' and 1 that it was 'extremely effective'.

10.5.5.3 Satisfaction rating

For satisfaction with the bridle in general, the owners rated it a mean of 3.2 on a scale from 1 to 6 (SD 1.60, median 4, range 1–6, N = 27), which equates to a median rating of 'quite satisfied' (see Appendix IX for the satisfaction scale in the assessment form). 5 owners were 'dissatisfied' with the bridle, 6 found it 'hard to say', 2 were 'slightly satisfied', 8 were' quite satisfied', 4 were 'very satisfied' and 2 were 'extremely satisfied'.

10.5.5.4 Other comments

Every owner made additional comments regarding the effect of the bridle on the headshaking, their horse's general behaviour when ridden or the design of the bridle itself and these comments are summarised in Table 10.6. A total of 71 positive comments were lodged regarding the bridle and 27 negative ones. Positive comments included an improvement in the horse's general behaviour when ridden (28 comments) and an alleviation of the jerky action when the horse did headshake (6 comments). Negative comments included some difficulties experienced in riding (21 comments) and concerns over the tightness of the noseband (3 comments).

10.5.5.5 Decision to purchase

12 (41%) out of the 29 owners who were sent the bridle to test, opted to purchase it.

10.5.5.6 Withdrawals from the trial

Two owners failed to complete the assessment forms for their participation in the trial. One claimed that the bridle made no difference to the headshaking, and the other claimed that her daughter could not control the pony in the bridle and consequently did not continue with the trial.

10.5.6 Post hoc power calculation

The *overall severity* of the headshaking at baseline had a mean (SD) of 3.2 (1.1). With the use of the bridle for 2 weeks it had a mean of 2.7 (1.4). The estimated effect size was 0.40 and the power of this study using 27 horses to detect this was 0.30, calculated using G*Power v 2.0 (Faul and Erdfelder 1992).

Table 10.6. Positive and negative comments regarding the effect of the bridle.

Positive	*N*	Negative	*N*
Effects on headshaking			
Overall improvement seen	6		
More comfortable to ride when headshaking, i.e. less jerky	6		
General behaviour when ridden			
More control (brakes)	5	Less control (brakes)	6
Good to school in	3	Difficult to school in	2
'Goes well in it'	7	Difficult to steer	3
Stopped 'yawing' or chewing at the bit	2	Poked nose and stretched for the bit	1
More forward going	2	Felt 'heavy' in it	2
Rides loose and easy	1	Rides loose and easy (not in an outline)	1
More relaxed in the jaw	1	Head carriage much higher than usual	1
Horse more relaxed	2	Tight noseband made horse uncomfortable and harder to ride	3
Stopped raising its head to be bridled	1	Sense of uneven rein lengths	2
Horse seemed happier in it	3		
Softer and rounder to ride	1		
Design of the bridle			
Easy to put on	1	Tight noseband caused lumps on nose	2
Nice fit	2	Horse sweated under nose band	2
Horse accepted it well	1		
Comfortable for horse	1		
Well made	1		
Easy to clean	2		
General comments			
Owner liked it	11	Could not use in competition	2
Horse liked it	4		
More humane	3		
Liked the principle of the bridle	5		

10.5.7 Follow up, one year later

A year after concluding the trial, 6 of the 12 owners who had purchased a bridle were continuing to ride their horse regularly in it. One horse had since been subject to euthanasia due to the headshaking and associated problems. Of these six, four (67%) were reported to have improved since the trial and none had deteriorated over this time, see Table 10.7. Of the remaining owners who either did not continue to ride their horse regularly in the bitless bridle or had not purchased one, 8 reported that their horse had improved since the trial (36%). 11 owners claimed their horse had not changed since this time and 3 reported that their horse had deteriorated.

Table 10.7. Reported improvement in headshaking and use of the bitless bridle a year from the trial, *N*=28.

Purchased?	Use of bridle	Change in headshaking			Total
		Improved	No change	Deteriorated	
Yes	Continual	1	1	0	2
	Regular	3	1	0	4
	Occasional	1	0	1	2
	Never	1	1	1	3
No	Never	6	10	1	17
Total		12	13	3	28

10.6 Discussion

There was some evidence to suggest that use of the bitless bridle, at least in the short-term, might reduce the overall severity and occurrence of headshaking, in horses considered by their owners to be suffering from this problem. There was statistically significant improvement reported in *overall severity* after only two weeks of ridden exercise in the bridle ($p = 0.026$), but the size of this improvement was small, by 9% on average. Over 50% of horses were reported to have improved by at least 10% from their baseline score in *overall severity* when being exercised in the bridle, but only a handful of horses (5) were reported to improve by 50% or more.

There was also statistically significant improvement in *size of headshake*, frequency of *flipping the nose/top lip* and the likelihood of the horse headshaking *in trigger spots*, *in bright sunlight* and *in the wind*. But the size of the improvement in these measures was also small. A high proportion of horses were not reported to change or actually deteriorated over the course of the trial. The median percentage improvement ranged from 0% in 8 of the 15 headshaking measures listed, including *vertical headshaking*, to 17% for *rubbing the nose on the foreleg*. The rating for the efficacy of the bridle appears to reflect these findings, with the average opinion being one of 'hard to say' and six owners rating the bridle as at least 'partially effective'.

Given the multiple aetiology of headshaking, it was not expected that all horses in the trial would benefit from ridden exercise without a bit. In addition, the relatively small sample size and the lack of a placebo or suitable control device, means that no reported improvements can be attributed to the bridle without qualification. For example, the two horses that had been reported to completely cease headshaking during the assessment of the bridle were reported to have resumed headshaking immediately following the trial but whilst the bridle was still in sole use. Similarly, the small number of horses participating in the trial and being reported to particularly benefit as a result (around six horses), precludes any valid assessment of factors that might have been indicative of success with the bridle. Given the smaller than anticipated effect size, estimated to be in the order of 0.4, the power of the study to detect a significant effect was low.

The small but significant improvement reported in particular behavioural signs and situations may have occurred purely by chance or may indicate that the syndrome was beginning to regress. Cook (pers. comm.) suggested that since, in his experience, the syndrome often develops gradually with headshaking being one of the last signs to appear, it is possible that it is one of the last ones to regress following treatment. The larger percentage of horses being reported to improve by 50% or more for signs such as *rubbing the nose*, *dropping the nose to the ground* and *flipping the nose* might indicate that these are the first signs to regress. Additionally, or alternatively, these signs might be more indicative of neuralgia in a different location of the head which presents as external naso-facial irritation and which responds better to removal of the bit. This is worth further investigation.

The question relating to satisfaction with the bridle suggests that the bridle had a positive effect on the owners over and above that reported for its efficacy. Over 50% of the owners claimed that they were at least 'quite satisfied' with the bridle and over 40% decided to purchase it. Several owners reported that they 'liked it' (11 comments), that the horse 'went well in it' (7 comments) or that the horse seemed 'relaxed' or 'happier in it' (5 comments). Interestingly, several commented that, whilst the bridle did not improve the headshaking directly, it made it easier to cope with. This seemed to be a consequence of increased control of the horse (5 comments) or the fact that without a bit the rider felt less connected to the horse's mouth and thus the headshaking movement had less effect on them (6 comments). Some owners reported an eradication of some signs of bit aversion other than those listed as part of the headshaking syndrome (4 comments) and improvement in the horse's schooling or movement (7 comments). However these reported changes may be due to the use of novel response points for schooling, i.e. the poll and sides of face as opposed to the lips and bars of the mouth. The horse may have become habituated to the use of the bit or failed to respond to inconsistent use of it and simply responded better because it was being given new aids.

As would reflect the usual situation if a horse owner purchased a bridle, there was no direct supervision of the fitting and use of the bridle. As a consequence there were a few comments regarding problems with the fit of the bridle, particularly the tightness of the nose band, and turning or stopping when riding in the bridle. In hindsight, two weeks was perhaps not enough time for the owner and horse to become used to riding in a new bridle with a different mechanism of action. However, it is unlikely that the owners would have persisted any longer if they failed to see any change in their horse (see Section 9.5). Assessing the change in the horses on a more long-term basis was difficult upon follow up since nearly half the owners failed to continue to ride their horse regularly in the bridle after its purchase. There was some suggestion in the owner's comments during the trial that this might have been due to difficulties in schooling the horse in dressage when wearing the bridle and current competition rules not permitting its use.

Two weeks may not have been sufficient time to observe significant improvement in the headshaking syndrome, particularly as the horses participating in the trial were largely 'middle-aged' with a long history of headshaking problems. Although the owner may have had the opportunity to exercise the horse in the bridle on only a few occasions over the trial period (an average of 7 occasions in total) the horse would have also had relief from the bit during this time. As a result, the study does not appear to support the first two explanations for headshaking given in the introduction, at least in this population in general. If horses were throwing their heads in response to psychological or physiological confusion caused by the presence of the bit in the mouth whilst exercising (Cook 1992a), or in order to avoid asphyxiation by extreme poll flexion (Cook 1992), one would expect this to be eradicated almost immediately by use of the bitless bridle. However, if the bit is the cause of a neuralgia then it is possible that this might continue long after the bit has been removed, particularly if there are also learned components to the headshaking behaviour. In neuralgic cases, pressure of the bridle on the face might be another trigger for the pain and so mask any change as a result of removal of the bit.

Nonetheless, in only two weeks there was evidence that some signs of headshaking were beginning to regress. A longer term study of perhaps 2 months in mid-summer might therefore be a worthwhile recommendation. (A study any longer than this will be affected by the tendency for signs in many horses to regress towards the end of summer, see Section 9.5.) However, more than the 20 bridles available to this study would be required in order to increase the sample size for the determination of possible prognostic factors, since reusing unwanted bridles, as occurred here, will not be possible. A particularly interesting longitudinal study would be to evaluate the incidence of headshaking syndrome in horses that had been exercised solely in the bitless bridle their entire lives compared to those that are normally ridden in bits. However, difficulties in obtaining sufficient numbers of such horses to determine incidence and obtaining the commitment of owners for a long period of time, whilst controlling for other factors e.g. type of use, currently mitigates against this sort of study.

Chapter 11

Part IV:

Assessment of management aids for equine headshaking syndrome:

1. A field trial of a light-limiting face mask

11.1 Introduction

Cook (1980a) listed photophobia as a potential cause of headshaking and suggested covering the horse's eyes as a simple diagnostic test for this (Cook 1979b). Since then, limiting the exposure of the eyes to sunlight of a horse with a headshaking problem has been regarded as beneficial, particularly in the USA (Wilkins 1997). Five horses that were blindfolded in the study by Madigan *et al.* (1995) ceased to headshake as soon as this had been done, and had all been reported to be worse on bright, sunny days. The authors suggested that the mechanism by which sunlight might trigger a headshaking attack was similar to that proposed for 'photic sneezing' in humans (Everett 1964, Pies 1990), and termed the condition 'photic headshaking'. In a more recent survey of 109 headshakers, mostly from the USA, the same researchers reported that many of the horses benefited from blindfolding or wearing a thick face mask (Madigan and Bell 2001). 51% of the 73 owners who had tried this method reported considerable improvement in their horse's headshaking.

However, in a recent study of British headshakers by Newton *et al.* (2000) only two horses out of 16 benefited from the use of tinted contact lenses to limit the exposure of the eyes to light. For both, the effect did not last more than one week. In the survey by Mills *et al.* (2002a), 64% of 253 horses were reported by their owners to be worse on bright, sunny days. However, in a section relating to treatments, only 8% of 51 owners who had tried a face net on their horse reported complete success with it (Mills *et al.* 2002b). Similar results were found with the survey described in Chapter 3. Because of the discrepancies between these reports of British and American horses, there seems to be a feeling among the veterinary community that headshakers in the UK are less likely to be 'photic' than those in the USA. 'In UK cases, it seems that light avoidance is not as helpful as it is in the USA' (Knottenbelt 1998). This might be surprising given marked similarities in the general presentation of the condition of the horses in Madigan and Bell's study and those in Mills *et al.* (2002a) and Chapter 3 (see Chapter 4 where the surveys are compared). However, since only a proportion of horses had tried a face mask in these studies, any differences in the presentation of the syndrome between those that were reported to benefit from it, and those that were not, could not be compared between the two groups. Doing so may highlight characteristics of the horses that predict the photic component.

The variation in success rate between the British and American studies may be in part due to variation in the method of covering of the eyes and in the way response has been measured. Madigan *et al.* (1995) reported using a range of facial coverings; blindfolding, a light-limiting face mask and the use of grey plastic lenses taped to a face mask to study the effects of light withdrawal on their sample of horses. Newton *et al.* (2000) used blue or green tinted contact lenses that were left in the horse's eyes for 5-7 days, but did not report the extent to which the lenses reduced the level of light to the eyes. The question relating to covering the eyes in the survey by Madigan and Bell (2001) referred to blindfolding or shading the eyes and the level of improvement reported by the owner or veterinary surgeon was open-ended. In the survey by Mills *et al.* (2002b) and that described in Chapter 4, the treatment listed was a face net, and the response in the latter survey measured in 4 levels (none, partial, substantial, complete).

The extent to which facemasks restrict the amount of light to the horse's eye probably varies depending on the purpose for which the mask is intended. Masks specifically marketed for photophobia would be expected to be more effective at restricting the amount of light reaching the eye than a face net used for protecting the horse's face from flies. As a consequence they would be expected to be more effective at reducing photic headshaking. To date, no study has tested the effects of a single method of covering the eyes on a reasonably sized sample of horses with a headshaking problem in the UK. If it is found that the response rate is different to that reported in Madigan and Bell (2001), then a comparison of the two studies, using only horses that had tried a mask, might find differences in their characteristics that explain this.

The Guardian mask is a facemask that is specifically marketed for photic headshaking (and other ocular problems requiring protection of the eye from the sun and airborne particles) in the US. It is used by veterinary surgeons for the diagnosis of photic headshaking, such as occurred in Madigan *et al.* (1995). But, since the design of the mask makes it possible for the horse to wear it continually without severe limitation of vision, owners frequently continue to use the mask as a preventative management aid for headshaking (Eby pers. comm.). The mask is a mesh-type, face cover made from synthetic material with detachable, reinforced eye covers, see Fig 11.1. The eye covers are claimed to reduce UV light to the eyes by 95% (Guardian mask ™ promotional material). The mask covers the facial area as well as the eyes, but does not cover the muzzle or the ears. It fastens to the head via Velcro straps behind the poll and under the throat. The mask is expected to immediately reduce photic headshaking but it is recommended that the mask is worn whenever the horse is outside to prevent headshaking attacks when the horse is not ridden (Eby pers. comm.). A pilot trial of the facemask on two horses over the winter of 2000, suggested that a larger trial of this mask would be worthwhile.

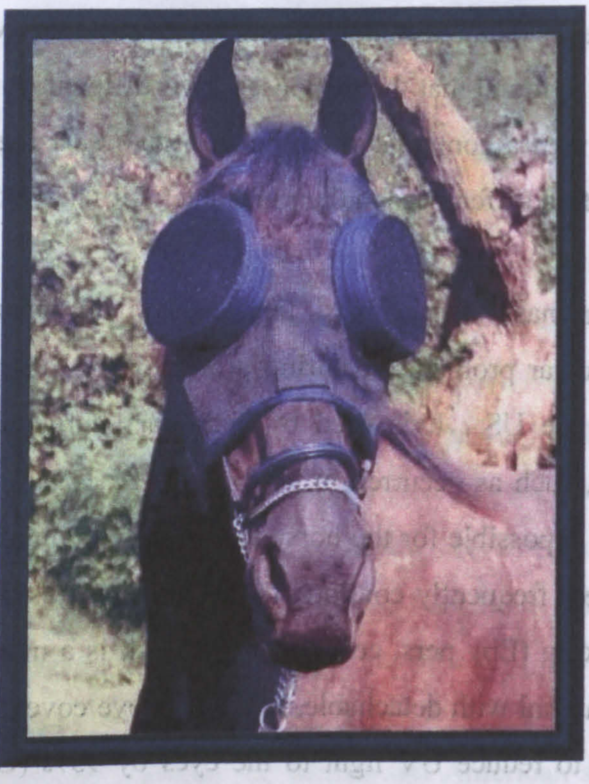

Fig. 11.1 The Guardian Face Mask ^{TM} (Reproduced from the Guardian mask website, www.guardianmask.com/GM.html)

11.2 Aims

The aim of the study was to test the hypothesis that:

1. Use of the Guardian face mask over a short period of time would reduce the occurrence and severity of headshaking signs in a selection of horses considered by their owner to have a headshaking problem.
2. The characteristics of horses from the study of Madigan and Bell (2001) that had benefited from covering the eyes would differ to the horses in this study

11.3. Trial method

The trial was designed as a simple efficacy and safety field evaluation. Interested owners were asked to complete a baseline assessment of the occurrence and severity of their horse's headshaking problem, as described in Section 9.8, for one week. During this time a face mask was sent to the owner. Instructions as to the fitting and use were included with the mask. They were asked to assess their horse's headshaking behaviour for a period of two weeks when the horse was ridden in the mask (and no other device to control the headshaking). The owners were instructed to put the mask on the horse immediately prior to and during all ridden exercise and, when possible, whenever the horse was outside (following the trial they were asked if they had managed to do the latter). An identical treatment assessment form regarding the horse's behaviour during ridden exercise when wearing the facemask was completed for the latter of the two weeks. This was then returned to the researcher, together with the mask, unless an agreement to purchase it at a reduced price had been made.

Measures of primary importance were change in the occurrence of *vertical headshaking* during the course of a typical ride, assessed on a sliding 0–6 scale and change in *overall severity* assessed on a similar scale. Secondary measures included change in six other headshaking signs, size of the headshake and likelihood of headshaking occurring in six situations. See Chapter 9 for details of the trial organisation and assessment, and Appendix IX for a copy of the assessment form.

Recruitment of horses onto the trial started on 1st May 2001 and ceased on 30th September 2001. A total of 24 facemasks (10 extra large, 13 large and 1 small) were available for the purposes of the trial. Allocation to the trial was made at random, without a probabilistic design, although start dates were set depending on the availability of the horse, its owner and a mask of the correct size.

11.4 Additional information

11.4.1 UV filtering ability of the mask

In order to test the extent to which the mask filtered out UV light, a small section of the material constituting part of the 95% eyepieces was removed and placed in a UV/visible spectrometer (Unicam UV2-100 v4.00). A reading of the percentage amount of UV/visible light (in the wavelength band between 200-900 nanometres) passing through the material was recorded.

11.4.2 Post hoc comparison of horse details with Madigan and Bell (2001)

Following the trial, the details of the horses that were reported to have experienced blindfolding or wearing a thick facemask in the study by Madigan and Bell (2001) were made available to the researcher. The details and headshaking behaviours of these horses and those of the horses involved in this trial were summarised in tabular form. Horses from each study were split into those that were reported to benefit 'considerably' from the face mask and those that were reported to benefit only slightly or not at all. These were the categories used in Madigan and Bell (2001). Horses from the trial described here were put into these categories depending on whether the owner reported the mask to be 'very effective' or better, or not. Details regarding the horses in this trial were taken from those submitted to the Q2000 survey described in Chapter 3 since this method of data collection was more similar to that of Madigan and Bell (2001), i.e. based on owner recall of the horse's usual headshaking behaviour. All characteristics that were similarly worded between the two surveys were compared. These were;

- Sex of horse (gelding or not)
- Thoroughbred (including crosses) or not
- Mean age of onset of headshaking problem
- Sunny seasonally affected or not (spring to autumn only)
- Reported presence of vertical headshaking (or not)

- Reported presence of horizontal headshaking (or not)
- Reported presence of 'acting like bee flew up the nose' (or not)
- Reported presence of snorting (or not)
- Reported presence of sneezing (or not)
- Reported presence of rubbing the muzzle on objects (or not)
- Reported presence of dropping the nose to the ground (or not)
- Reported presence of striking at head or face with foreleg (or not)
- Reported presence of headshaking at rest (or not)
- Headshaking reported to be worse on bright, sunny days (or not)
- Headshaking reported to improve at night (or not)
- Avoidance of sunlight reported (or not)

Reports of headshaking behaviour from Q2000 were taken if the horse was reported to show the behaviour at any state of exercise. Whether the horse shook its head at rest was taken from if the horse was reported with any form of headshaking (*vertical*, *horizontal*, or *rotary*) when 'in the stable' or 'when grazing'.

The prevalence of sign was compared between the following samples using the chi-square test of association (SAS v 8.0, SAS Institute, Inc):

1. The horses in Madigan and Bell (2001) that were reported to improve considerably from covering the face, and those that were not

2. The horses in Madigan and Bell (2001) that were reported to improve considerably from covering the face, and those from the trial described in this chapter that were not

11.5 Results

11.5.1 Basic characteristics of horses in the trial

A total of 26 horses participated in the trial of the light-limiting facemask, although complete records were available only from 22. Table 11.1 lists the basic characteristics of the horses participating in the trial. A range of breeds and ages were represented. Most horses were geldings, were used primarily for pleasure and had had the problem for a number of years. 81% of the horses had a headshaking problem that the owner considered to be at least 'unpleasant' when at its worst. All horses had a sunny seasonal component to their problem, although 54% were reported to suffer to some extent all year round.

Table 11.1. The basic characteristics of the horses participating in the trial of the light-limiting facemask.

Characteristic	Trial participants
Number of horses	26 (complete records available for 22)
Sex	19 geldings (73%), 7 mares
Breed type	4 thoroughbreds, 10 cobs, 4 ponies, 8 others, no warmbloods
Use	17 primarily pleasure 9 affiliated/professional competition
Age	Mean 11.75 years, SD 5.5 years Median 10.5 years, Range 5.25–32 years old
Seasonality of headshaking	12 sunny seasonal 14 perennial with seasonal exacerbations
Severity rating of headshaking	0 (barely noticeable), 5 (bearable) 12 (unpleasant), 9 (unrideable)
Known to be headshaking for (to nearest ¼ year)	Mean 5 years , SD. 3.5 years Median 4.5 years, Range 1–15 years

11.5.2 Conditions during the course of the trial

Throughout the trial, the horses were exercised for the purpose of assessment 3.0 occasions each week on average (SD 1.66, median 3, range 1–8, $N = 44$). However, there was a tendency for the owners to ride the horse *less* during the treatment assessment (i.e. with the mask) (mean difference –0.73, SD 1.75, median 0, Wilcoxon signed-rank test; $Z = -1.90$, $N = 13$ for test, $p = 0.058$).

Throughout the trial, the variability score of the headshaking was rated as 3.3 on average (SD 1.98, median 3, range 0–6, $N = 41$), which suggests that the headshaking varied between being consistent and inconsistent, i.e. 'hard to say'. There was no significant difference in the variability score between baseline and treatment assessments (mean difference 0.26, SD 1.85, median 0, Wilcoxon signed-rank test; $Z = 0.65$, $N = 12$ for test, $p = 0.519$).

12 (55%) horses were reported to have worn the mask whenever outdoors (when grazing and when ridden). The remaining 10 participants reported only putting the mask on their horse immediately prior to, and whilst being ridden.

A section of the eye piece of the mask was found to absorb 92% of all UV and visible light wavelengths.

11.5.3 Treatment–baseline difference in headshaking

Although there was a tendency for improvement rather than deterioration, the median change in *overall severity* and frequency of *vertical headshaking* when riding in the mask did not differ significantly from zero, p>0.05, see Table 11.2.

Table 11.2. The median scores for *overall severity* and frequency of *vertical headshaking* at baseline (out of *N* horses with a score) and the median treatment–baseline difference, d. Also shown are results from Wilcoxon signed-rank tests of the significance of the difference of d from zero for each measure (Test statistic, *Z*, *N* for test (differences of zero are ignored) and p-value).

Measure	*N*	Median baseline score	Median change, *d*	*Z*, test statistic	*N* for test	P
Overall severity	22	3.6	–0.2	–0.99	20	0.321
Vertical headshaking	22	3.5	–0.2	–0.88	19	0.379

For only one out of the 12 other measures of headshaking was there a statistically significant improvement from baseline; frequency of *rubbing nose on foreleg* (median change –0.7, p=0.018), see Table 11.3. There was a trend for improvement in the frequency of *rubbing the nose on objects* (median change –0.2, p = 0.057), but for all others the median change from baseline was close to or equal to zero.

Table 11.3. The median score for each headshaking measure at baseline (out of *N* horses with a score) and the median treatment–baseline difference, *d*. Also shown are results from Wilcoxon signed-rank tests of the significance of the difference of d from zero for each measure (Test statistic, *Z*, *N* for test and p-value).

Measure	*N*	Median baseline score	Median change, *d*	*Z*, test statistic	*N* for test	p
Snorting or sneezing	20	3.2	–0.1	–0.75	18	0.455
Dropping nose to ground	16	2.2	–0.1	–1.38	13	0.168
Rubbing nose on objects	18	2.4	–0.1	–1.90	15	0.057
Rubbing nose on foreleg	19	3.3	–0.7	–2.36	18	0.018
Striking at nose	16	1.7	–0.2	–1.56	15	0.120
Flipping nose/top lip	16	1.5	–0.1	–0.99	13	0.322
Likelihood of headshaking when:						
Excited	18	3.5	0.0	+0.79	6	0.432
In bright sunlight	19	5.0	0.0	+1.29	10	0.199
In the rain	16	2.0	0.0	–0.38	5	0.703
In the wind	13	3.0	0.0	+0.09	4	0.931
At rest	20	0.0	0.0	+0.58	3	0.564
In trigger spots	20	5.5	0.0	+0.02	8	0.983
Size of headshake	22	3.5	0.0	–0.79	17	0.432

11.5.4 Percentage improvement from baseline

For the measures of *a priori* primary importance, more horses were reported to have improved from baseline when riding in the mask than were reported to have worsened, see Table 11.4. However, a large proportion of horses were not reported to have changed, especially in frequency of *vertical headshaking* (41%). 23% of horses improved by 50% or more from their baseline score for *vertical headshaking* when using the mask and 14% of horses in *overall severity.*

Table 11.4. The number of horses (out of *N* with a score at baseline) that were reported to have deteriorated or improved from their baseline score by at least 10% for *overall severity* and frequency of *vertical headshaking* when being exercised in the facemask. Also shown is the percentage of horses (out of *N*) that were reported to have improved by 50% or more of their baseline score.

Measure	***N***	**Worse 10%+**	**No change**	**Improved 10%+**	**Improved 50% +**
Overall severity	22	8	4	10	3 (14%)
Vertical headshaking	22	4	9	9	5 (23%)

For the secondary signs, the largest percentage of horses reported to have improved by at least 50% from their baseline score was for frequency of *striking at nose* (38%), see Table 11.5. 33% were reported to have improved by at least 50% in frequency of *rubbing nose on objects* and 32% in *rubbing nose on foreleg*. The percentage of horses reported to have improved by at least 50% was less than this for the other headshaking signs. Horses tended not to be reported to have changed in their likelihood of headshaking in various situations when wearing the mask. In some situations more horses were actually reported to have deteriorated than improved, i.e. the headshaking was reported to be more likely to occur. For example, for tendency to headshake *in bright sunlight*, 7 horses were reported to have deteriorated compared to 3 that were reported to have improved. The percentage of horses improving by 50% or more from baseline for each of the situations was small–less than 15%. 14% of horses were reported to improve by at least 50% in the *size of the headshake*.

11.5.5 Other measures of potential efficacy

11.5.5.1 Latency to headshake

In the baseline assessment, three horses (14%) began to headshake immediately upon exercise. 14 horses (64%) did not begin to headshake until after they were asked to trot (5 minutes) and 11 of these (50% of the total) until at least 10 minutes into exercise. During the treatment assessment, 9 horses (43%) reportedly increased, five (24%) did not change and 7 (33%) decreased in their latency to headshake, i.e. worsened.

Table 11.5. The number of horses (out of *N* with a score at baseline) that were reported to have deteriorated or improved from their baseline score by at least 10% when wearing the facemask, for each headshaking measure. Also shown is the percentage of horses (out of *N*) that were reported to have improved by 50% or more of their baseline score.

Measure	*N*	Worse 10%+	No change	Improved 10%+	Improved 50% +
Snorting or sneezing	20	5	6	9	4 (20%)
Dropping nose to ground	16	4	5	7	4 (25%)
Rubbing nose on objects	18	3	5	10	6 (33%)
Rubbing nose on foreleg	19	4	2	12	6 (32%)
Striking at nose	16	4	4	8	6 (38%)
Flipping nose/top lip	16	4	5	7	3 (19%)
Likelihood of headshaking when:					
Excited	18	4	12	2	1 (6%)
In bright sunlight	19	7	9	3	1 (5%)
In the rain	16	2	11	3	2 (13%)
In the wind	13	2	9	2	1 (8%)
Resting	20	2	17	1	0 (0%)
In certain trigger spots	20	4	12	4	1 (5%)
Size of headshake	22	6	9	7	3 (14%)

11.5.5.2 Efficacy rating

The mean efficacy rating of the mask, as rated by the owners was 2.1 on a scale of 1 to 6 (SD 1.19, median 2, range 1–4, $N = 22$). The median score equates to an efficacy rating of 'hard to tell' (see Appendix IX for the efficacy scale in the assessment form). 10 owners (45%) rated it as 'totally ineffective', 4 found it 'hard to tell' and 4 reported that it was 'slightly effective'. The highest rating the mask achieved was 'partially effective' (a score of 4 out of 6) and 4 owners (18%) scored it as such.

11.5.5.3 Satisfaction rating

For satisfaction with the mask in general, the owners rated it a mean of 2.0 on a scale from 1 to 6 (SD 1.05, median 2, range 1–4, $N = 22$), which equates to a median rating of 'hard to say' (see Appendix IX for the satisfaction scale in the assessment form). 10 owners were 'dissatisfied' with the mask, 5 found it 'hard to say' and 5 were 'slightly satisfied'. The highest satisfaction rating the mask achieved was 'quite satisfied' (a score of 4 out of 6) and only 2 owners (9%) out of the 22 with completed forms rated it as such.

11.5.5.4 Decision to purchase

Only 2 owners (8%) out of the 26 to whom it was sent to test, opted to purchase the mask. These were the two owners that reported that they were 'quite satisfied' with the mask, see above.

11.5.5.5 Other comments

Every owner made additional comments regarding the effect of the mask on their horses' headshaking, general behaviour or on the design of mask itself (including those that failed to complete all the forms). The comments are summarised in Table 11.6. 22 positive comments were lodged and 28 negative ones. Negative ones included a difficulty in getting the horse to accept it (7 comments), the horse's lack of vision when wearing it (6 comments) and difficulty in keeping the mask on when the horse was in the field (3 comments). Positive comments included its ability to work as a fly shield (6 comments).

11.5.5.6 Withdrawals from the trial

Four owners withdrew their horse from the trial. Two reported a 'slight improvement' in their horse when wearing the mask but declined to complete the assessment forms. The other two reported that their horse became distressed when they attempted to put the mask on it so they did not continue with the trial.

11.5.6 Post hoc power calculation

The overall severity of the headshaking at baseline had a mean (SD) of 3.4 (1.4). With the use of the mask for 2 weeks it had a mean of 3.2 (1.4). The estimated effect size was 0.14 and the power of this study using 22 horses to detect this was 0.07, calculated using G*Power v 2.0 (Faul and Erdfelder, 1992).

Table 11.6. Positive and negative comments made by owners regarding the effect of the mask on their horse's headshaking, general behaviour and the design of the mask, *N*=26.

Positive	*N*	Negative	*N*
Effects on headshaking itself:			
Overall improvement seen	5	Deterioration of headshaking seen	4
General behaviour:			
Horse seemed happier in it	2	Problems with visibility (tripping, hesitancy)	6
Effective as a fly shield	6	Horse objected to wearing it	7
Subdued the horse, reducing the shaking	1	Mask came off in the field	3
		Lack of nose cover increased sunburn	1
Design of the mask:			
Horse accepted it well	5	Rubbing	3
Easy to put on	3	Sweating under it	2
		Poor appearance	2

11.5.7 Post hoc comparison of horse details with Madigan and Bell (2001)

The basic details of the horses that had experienced covering the eyes as a method of reducing the headshaking in the study by Madigan and Bell (2001), N=73, were compared with the horses in this study. Each group of horses was divided by the reported success of this method. Since none of the horses in this study fell into the 'considerable' success group, only three groups are presented in Table 11.7. The horse details were therefore compared within the Madigan and Bell group–'considerable success' and 'no success', and between their 'considerable success' group and the 'no success' group from this study (all horses in this study).

Within the survey by Madigan and Bell (2001), there were no significant differences in the proportion of horses reported with any of the headshaking signs between those that experienced considerable success with covering the eyes and those that did not ($p>0.05$). There was however, a significant difference in the proportion of horses reported to be affected at rest (chi-square = 4.00, $p = 0.045$), by bright, sunny days (chi-square = 15.55, $p<0.001$) and improve at night (chi-square = 10.27, $p = 0.001$).

However, there was no significant difference in these measures between the horses in this study that did not improve considerably as a result of covering the eyes and those that did from Madigan and Bell's study ($p>0.05$). However, there were significant differences between these two groups with respect to the proportion of thoroughbreds (chi-square = 4.59, $p = 0.032$), the proportion affected seasonally (chi-square = 6.72, $p = 0.010$) and the proportion reported to drop their noses to the ground (chi-square = 6.02, $p = 0.014$). More horses in the study by Madigan and Bell that improved when their eyes were covered were reported to be thoroughbreds and affected seasonally, but more horses in this study were reported to drop their noses to the ground, see Table 11.7. There was a non significant tendency for horses that improved with covering the eyes in Madigan and Bell to be more often reported to be affected at rest (chi-square = 3.71, $p = 0.054$) and to improve at night (chi-square = 2.87, $p = 0.090$) but the number of horses compared was relatively small.

Table 11.7. The characteristics of the horses that had experienced covering of the eyes in Madigan and Bell (2001) with considerable success, slight or no success and the horses in this trial which experienced slight or no success. *N* is given where it was less than the sample due to non-report.

Study sample	Madigan and Bell (2001)		This trial
Owner rated improvement	Considerable	Slight/none	Slight/none
Number of horses	37	36	26
Geldings	78%	72%	73%
Thoroughbreds (incl. crosses)	41%	58%	27%
Onset age, mean (median)	9.5 (9)	8.0 (8)	6.8 (5)
Sunny seasonal	81% (*N*=26)	66% (*N*=29)	46%
Vertical headshaking	92%	92%	92%
Horizontal headshaking	35%	53%	35%
'Bee up nose'	89%	92%	73%
Snorting	68%	81%	77%
Sneezing	49%	50%	62%
Rubbing muzzle on objects	78%	83%	85%
Dropping nose to ground	38%	50%	69%
Strikes at head/nose with foreleg	54%	50%	65%
Headshaking at rest	70%	47%	46%
Avoids the sunshine	49%	31%	40% (N=20)
Worse on bright, sunny days	84%	39%	79% (N=24)
Reduced symptoms at night	78%	42%	54% (N=13)

11.6 Discussion

There was no evidence of significant improvement in the measures of primary importance; *overall severity* and *vertical headshaking*, when the horses were exercised in the Guardian facemask. Less than 50% of the horses were reported to have improved by 10% in *overall severity.* There was a statistically significant improvement for only one of the twelve secondary measures; *rubbing the nose on foreleg* (p = 0.018). Over 30% of horses were reported to improve by 50% or more from their baseline score for the signs *rubbing the nose on objects, rubbing the nose on foreleg* and *striking at the nose.* The percentage of horses improving by this amount was lower than this for all the other measures. In particular only one horse was reported to have improved by 50% or more in the likelihood of it headshaking *in bright sunlight.* The limited success of the mask was mirrored by the ratings for efficacy and satisfaction given by the owners. None of the owners in the trial rated the mask higher than 'partially effective', and only 18% (4 out of 22) gave it this score. There was also a tendency for owners to exercise their horse less often when wearing the mask than they did prior to the trial, which may reflect its lack of effect and/or problems with reduction in visibility for some horses.

Given the likely multiple aetiology of headshaking, it was not necessarily expected that all horses on the trial would benefit from ocular protection from the sunlight. However, the relatively small sample size and the lack of a placebo or suitable control device, means that one cannot confidently attribute any of the reported improvements solely to the mask. Similarly, the small proportion of horses reported to benefit at least partially from the use of the mask (around 4 horses), precludes any valid assessment of factors that might have been indicative of its success. Given the good response to covering the eyes in the study by Madigan *et al.* (1995) and Madigan and Bell (2001), the estimated size of the effect of covering the eyes in this study was much smaller than anticipated. And, as a result, the power of this study to detect a significant effect was extremely low. Given the observed effect size of 0.14, a sample of over 900 horses would be needed to have 90% confidence that a significant effect would be detected. A trial of this size is not feasible.

These results are in contrast to those reported by Madigan *et al.* (1995) in their referral sample and in their survey sample (Madigan and Bell 2001). In the latter study, 51% of 73 horses were reported by their owners to have improved considerably when blindfolded or when wearing a light-limiting mask. In the study described herein none of the horses were reported to respond considerably. A comparison of the characteristics of the two groups of horses found little to explain this discrepancy, although the number of horses for some comparisons was small. There was some evidence to suggest that the horses from the study by Madigan and Bell that responded to covering the eyes were more likely to be thoroughbreds and affected seasonally. The latter finding would follow with the hypothesis of photic headshaking. The higher proportion of thoroughbreds may have more to do with differences in the horse populations between the UK and USA (see Chapter 4). The tendency for horses from this study to be more likely to be reported to drop the nose to the ground, and less likely to be affected at rest and to improve at night may reflect important differences between these horses and ones with a photic component to their problem. This is supported by the finding that, within Madigan and Bell's study, the proportions of horses with the latter two signs were also found to differ significantly between those that improved when their eyes were covered and those that did not.

Although the mask did provide substantial reduction of the amount of light to the eyes, 92% in spectrometry tests, the possibility remains that complete protection from the light (i.e. 100%) may be required in order to see an effect. Any reported effect may also be explained by its provision of protection of the face and eyes from flies and wind-blown particles. Comments by the owners regarding its efficacy as a fly shield support this conjecture. Newton *et al.* (2000) found that the use of tinted lenses was effective in only two cases and only temporarily. Their use of lenses removed the likelihood that any effect was due to facial protection from wind-blown particles. Since more horses in this trial were reported to improve than in the one by Newton *et al.* (2000), it is possible that these horses may have been benefiting from facial rather than ocular protection. However, as this effect appeared to be small, repeating the trial with the eyepieces removed in order to test this hypothesis was not attempted. The efficacy of the face mask compares poorly to that reported for a nose net (Mills *et al.* 2002b, Mills and

Taylor 2003). In the latter study, a trial conducted in a similar manner to this one, 59% of horses were reported to improve by at least 50% in overall severity when wearing a full nose net. The need for the muzzle to be covered more than the eyes in order to achieve improvement in the horse's behaviour was also indicated in the owner's comments regarding the face mask. Several owners felt the mask helped slightly by providing relief from flies, which can be a particular source of irritation to headshakers (Mills *et al.* 2002a). But, since there are more lightweight masks available for this purpose that do not cause problems with visibility and sweating, it was not surprising that uptake of the mask was low.

Since the mask is reported to produce an instant, positive effect (Madigan *et al.* 1995, Eby pers comm.) and the owners tested it on average six times over the course of the trial, some improvement should have been apparent to the owners over this period. There was some evidence that *rubbing the nose* might be reduced when wearing the mask, which is unusual given that the mask did not cover the muzzle. This might suggest therefore that some of the signs of headshaking were beginning to regress with the use of the mask, but given the multiple outcomes in the trial this result could have also arisen purely by chance (type I error). The results from this study suggest that the majority of headshakers of the kind used in this trial would not benefit substantially from protection of their eyes from the sunlight. This does, therefore, seem to support the contention that the incidence of the photic component of the problem is lower in the UK than in the USA. A comparison of the characteristics of US horses that did respond to ocular protection and those that did not (both from the US and in this trial) failed to find any evidence of difference in symptomatology. However, the trigger factors of 'season' and 'at rest' appeared to separate the horses. This provides support to the hypothesis that headshaking is a similarly presenting condition with different trigger factors.

Chapter 12

Part IV

Assessment of management aids for equine headshaking syndrome:

1. A double-blind, placebo-controlled, cross-over trial of a magnatherapy headcollar

12.1 Introduction

Magnatherapy is a form of alternative therapy increasingly used by horse owners, particularly in the treatment of various musculoskeletal injuries (Hudson and Hudson 1998). Products include horse boots, wraps and blankets that have magnets positioned within their layers. It is claimed that applying static magnets to a specific part of the body affects the movements of charged ions in the blood circulating in this area. This apparently leads to an increase in blood flow and therefore an increase in nutrient supply to, and waste product elimination from, the injured area, subsequently decreasing the healing time and pain associated with the site (Bioflex^{TM} promotional material). These claims regarding the mechanism of action of magnatherapy have been largely based on a study on the effect of static magnets on the flow of a concentrated saline solution in a capillary tube (Pratt and Misra 1989), but otherwise remain unsubstantiated (Ramey *et al.* 1998). However, recent controlled clinical trials of chronically painful conditions in humans have suggested that the use of magnets might significantly improve the subjective reporting of pain (post-polio pain–Vallbona *et al.* 1997, heal-pain–Seaman 1993). Therefore, if headshaking is due to a painful condition, such as trigeminal neuralgia, then applying magnets to the affected area may alter the perception of pain and remove the triggers that are causing the horse to headshake.

Application of magnets near to the surface of the skin of the horse's head is possible through the use of a headcollar that contains static magnets within its webbing. A magnetic headcollar of this kind was being marketed for non-specific equine problems by Magna-cell™ (Inspired Technology Ltd., Blackpool, UK). It is a black, nylon headcollar similar in all respects to a normal headcollar that is usually worn by the horse when it is grazing, see Fig. 12.1. However, it contained three, north polarity, button magnets of 2,200 Gauss each, sewn inside the throat lash so as to lie directly behind the ears on the poll. A pilot study of the magnetic headcollar on three, non-seasonal headshakers during the winter of 2000 produced some positive reports including an improvement in the reported severity and frequency of occurrence of some symptoms and an improvement the horse's general mood or 'well-being'.

However, as with all treatments, this improvement may have occurred for a number of reasons other than the application of the magnets. It may have occurred, for example, as a result of participation in a study, natural changes in the horse's headshaking and/or the application of a new headcollar. In order to 'control' for factors such as these, a placebo treatment can be applied, either to the same horse prior to or following the magnetic treatment or to a similar horse concurrently. In the case of a magnatherapy headcollar, the placebo is relatively easy to produce; an identical headcollar containing demagnetised buttons. The reported change in the horse following application of placebo can then be compared to that following application of the magnetised headcollar. This is an important tool to use to determine whether magnatherapy, as opposed to any other explanation, can help alleviate headshaking signs.

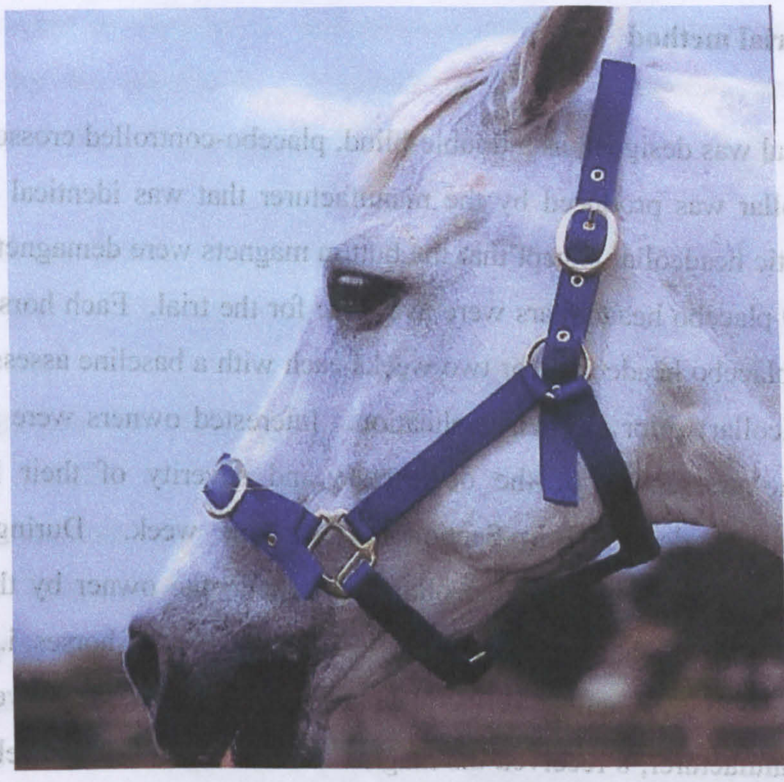

Fig. 12.1 A headcollar of the kind used in the trial.

12.2 Aim

The aim of the study was to test the hypothesis that the application of static magnets to the poll area of the horse would reduce the occurrence and severity of headshaking signs reported by the owner. This would be achieved by the use of a double-blind, placebo-controlled, cross-over field trial of a magnatherapy headcollar on a selection of horses believed by their owner to have a headshaking problem.

12.3 Trial method

The trial was designed as a double-blind, placebo-controlled crossover trial. A placebo headcollar was produced by the manufacturer that was identical in all aspects to the magnetic headcollar except that the button magnets were demagnetised. 20 magnetised and 20 placebo headcollars were available for the trial. Each horse wore a magnetised and a placebo headcollar for two weeks each with a baseline assessment made (without a headcollar) prior to each application. Interested owners were asked to complete a baseline assessment of the occurrence and severity of their horse's headshaking problem, as described in Section 9.8, for one week. During this time either a magnetised or a placebo headcollar was sent to the owner by the manufacturer (see Section 9.4.2 for how this was done). Equal numbers of horses, i.e. 10, were supposed to receive the magnetised or the placebo headcollar first. However, due to an error by the manufacturer, 8 received the magnetised first and 12 the placebo. Owners were not informed as to the identity of the headcollars until after the trial results had been analysed. For the purposes of deception, and to reduce the chances of owners testing the magnetic quality of the headcollars themselves, they were informed that they would be testing headcollars of 'different strengths of magnetism'. The researcher also remained ignorant of the identity of the headcollars until the results had been analysed and subsequent conclusions reached.

Instructions as to the fitting and use of the headcollar were included with each headcollar. Owners were asked to assess their horse's headshaking behaviour for a period of two weeks when the horse was ridden in the headcollar (under the usual bridle, but with no other device to control the headshaking). Throughout the treatment period, the owners were instructed to keep the headcollar on the horse for as long as possible (between 8–24hrs a day), when out in the field and when ridden. Apart from this, they were instructed to manage their horses as usual. An identical treatment assessment form regarding the horse's behaviour during ridden exercise when wearing the headcollar was completed for the latter of the two weeks. This was then returned to the researcher, and the second baseline period started (using no headcollar). Meanwhile, the second headcollar (the opposite of the one that had been tested) was sent to the owner for them to use and assess as they had done previously. Contact was maintained by the researcher via telephone to ensure baseline periods had been respected, headcollars had arrived and forms returned.

Measures of primary importance were change in the occurrence of *vertical headshaking* during the course of a typical ride, assessed on a sliding 0–6 scale and change in *overall severity* assessed on a similar scale. Secondary measures included change in six other headshaking signs, size of the headshake and likelihood of headshaking occurring in six situations. Initially, the change from baseline (treatment–baseline score) for each headshaking measure was presented for each treatment type (magnetic and placebo headcollar). Then a comparison of these scores was made between the treatment types (magnetic–placebo) to establish the significance of any reported improvement when using the magnetic headcollar over the placebo (within-horse differences). See Chapter 9 for details of the trial organisation and assessment, and Appendix IX for a copy of the assessment form.

Recruitment of horses onto the trial started on 1st June 2001 and ceased on 30th September 2001. A total of 20 headcollar pairs (magnetised and placebo) were available for the trial (12 large and 8 medium sized). Allocation to the trial was made at random, without a probabilistic design, in groups of 4 horses at a time, although start dates depended on the availability of the horse and its owner. Allocation to test either magnetised or placebo headcollar first was done at random by the manufacturer tossing a coin.

Following the trial, each owner was asked via telephone how long, on average, their horse had worn the headcollar each day and which headcollar, first or second, they thought was most effective.

12.4 Results

12.4.1 Basic characteristics of horses in the trial

A total of 20 horses participated in the trial and a summary of their basic characteristics is shown in Table 12.1. A range of breeds and ages were represented. Most horses were geldings, were used primarily for pleasure and had had the problem for a number of years. 80% of the horses had a headshaking problem that the owners considered to be at least 'unpleasant' when at its worst. All but one horse had a sunny seasonal component to their problem, but 45% were reported to suffer to some extent all year round.

There were no significant differences between the two allocation groups (magnetised or placebo tested first) with respect to sex, breed, use, severity rating or seasonality (Fisher's exact test, p-value>0.05). Neither was there any significant difference between the two groups with respect to age (Wilcoxon rank-sum test; $Z = 0.00$, N for test = 8, 12, p = 1.000) or number of years known to be a headshaker at the start of the trial (Wilcoxon rank-sum test; $Z = -0.59$, N for test = 7, 11, p = 0.555).

12.4.2 Conditions during the course of the trial

Throughout the trial the horses were exercised for the purpose of assessment on 3.5 occasions each week on average (SD 1.60, median = 4, range 1–7, $N = 79$). There was no significant difference in the number of occasions that the horses were exercised, between baseline and treatment assessments (Wilcoxon signed-rank test; $Z = -1.03$, N for test = 12, p = 0.302) or between treatment assessments for the placebo and magnetised headcollar (Wilcoxon signed rank test; $Z = +0.10$, N for test = 9, p = 0.918).

Table 12.1 The basic characteristics of the horses participating in the trial of the magnetic headcollar.

Characteristic	Trial participants
Number of horses	20 (complete records available for 20)
Sex	9 geldings (45%), 11 mares
Breed type	6 thoroughbreds, 7 cobs, 2 ponies, 3 others, 2 warmbloods
Use	15 primarily pleasure 5 affiliated/professional competition
Age	Mean 14.5 years, SD 4.75 years Median 12 years, Range 8–26 years old
Seasonality of headshaking	11 sunny seasonal 8 perennial with seasonal exacerbations 1 perennial
Severity rating of headshaking	0 (barely noticeable), 4 (bearable) 11 (unpleasant), 5 (unrideable)
Known to be headshaking for (to nearest ¼ year)	Mean 6.75 years , SD. 3 years Median 7 years, Range 2–15 years, N=18

Throughout the trial the variability score of the headshaking was rated as 3.7 on average (SD 1.61, median 4, range 0–6, $N = 76$) which suggests a tendency for the headshaking to be more consistent than not. There was no significant difference in variability score between baseline and treatment assessments (Wilcoxon signed-rank test; $Z = +0.39$, N for test = 23, p = 0.697) or between the magnetised and placebo treatment assessments (Wilcoxon signed-rank test; $Z = -0.56$, N for test = 10, p = 0.577).

Both magnetic and placebo headcollars were reported to be worn equally for an average of 15 hours a day (SD 6.4, median 12, range 5–24 hours, $N = 19$). 75% of the horses wore the collars for at least 12 hours a day.

With the exception of *size of headshake* where the baseline prior to receiving the placebo headcollar was higher (median score of 3.4 versus 2.7 prior to the magnetised; Wilcoxon signed-rank test, $Z = -2.44$, p = 0.015, $N = 16$ for test), there were no significant differences in the baseline headshaking measures prior to receiving the magnetised headcollar and the placebo (p>0.05).

12.4.3 Treatment–baseline difference in headshaking

There was no significant improvement in *overall severity* and frequency of *vertical headshaking* from baseline when the horses were wearing the magnetised headcollar (p>0.05), see Table 12.2. However, there was significant improvement in these measures when the horses were wearing the placebo headcollar, although, for each measure the median improvement was by less than one point on the seven-point scale, see Table 12.2.

Table 12.2. The median score for *overall severity* and frequency of *vertical headshaking* at baseline (out of *N* horses with a score) and the median treatment–baseline difference, *d*, for the magnetised (M) and placebo (P) headcollars. Also shown are results from Wilcoxon signed-rank tests of the significance of the difference of *d* from zero for each measure (Test statistic, *Z*, *N* for test and p-value).

Measure	Type	*N*	Median baseline score	Median change, *d*	*N* for test	*Z*, test statistic	p
Overall severity	M	19	2.8	0.0	15	–0.47	0.641
	P	19	3.4	–0.4	17	–2.86	0.004
Vertical headshaking	M	19	2.6	0.0	15	–1.16	0.248
	P	19	3.3	–0.5	15	–2.77	0.006

For all the secondary headshaking measures there was no significant change from baseline when wearing the magnetised headcollar, see Table 12.3. The median improvement was zero for 9 of the 12 secondary measures when wearing the magnetised headcollar. In contrast, there was a statistically significant change from baseline (improvement) for 7 measures when wearing the placebo headcollar, see Table 12.3. These were, *size of headshake* (median change = –0.9, p = 0.002), frequency of *snorting or sneezing* (median change = –0.7, p = 0.010), tendency to headshake *in the wind* (median change = –1.0, p = 0.011), frequency of *rubbing the nose on objects* (median change = –0.4, p = 0.012), *striking at the nose* (median change = –1.1, p = 0.015), tendency to headshake *in trigger spots* (median change = 0.0, p = 0.015) and tendency to headshake *in bright sunlight* (median change = 0.0, p = 0.017). A significant median change of zero is possible if more horses were reported to improve than deteriorate even if the median was zero.

Table 12.3. The median score for each headshaking measure at baseline (out of *N* horses with a score) and the difference from baseline, *d*, for the magnetised (M) and placebo (P) headcollars. Also shown are results from Wilcoxon signed-rank tests of the significance of the difference of *d* from zero for each measure (Test statistic, *Z*, *N* for test and p-value).

Measure	Type	*N*	Median baseline score	Median change, *d*	*N* for test	*Z*, test statistic	p
Snorting or sneezing	M	19	2.0	0.0	17	−0.26	0.793
	P	17	2.5	−0.7	15	−2.58	0.010
Dropping nose to ground	M	13	1.5	−0.1	11	−0.95	0.344
	P	13	2.0	0.0	9	−1.28	0.199
Rubbing nose on objects	M	15	2.3	0.0	9	−0.30	0.768
	P	16	2.8	−0.4	13	−2.52	0.012
Rubbing nose on foreleg	M	18	2.0	+0.1	13	+1.24	0.217
	P	17	2.0	0.0	12	−1.61	0.107
Striking at nose	M	12	1.6	−0.1	11	−0.67	0.503
	P	14	2.0	−1.1	10	−2.42	0.015
Flipping nose/top lip	M	15	3.4	0.0	12	−0.89	0.375
	P	17	3.4	−0.3	14	−1.90	0.057
Likelihood of headshaking when:							
When excited	M	13	4.0	0.0	2	0.00	1.000
	P	14	2.5	0.0	6	+0.74	0.461
In bright sunlight	M	20	5.0	0.0	11	+0.53	0.594
	P	19	5.0	0.0	9	−2.39	0.017
In the rain	M	16	1.5	0.0	5	+0.41	0.679
	P	15	1.5	0.0	6	−1.66	0.098
In the wind	M	19	3.0	0.0	12	−0.85	0.393
	P	16	4.0	−1.0	12	−2.55	0.011
At rest	M	19	0.0	0.0	4	+1.00	0.318
	P	19	1.0	0.0	6	−0.69	0.489
In trigger spots	M	19	6.0	0.0	8	−0.79	0.429
	P	20	6.0	0.0	9	−2.43	0.015
Size of headshake	M	19	2.7	0.0	14	−0.41	0.684
	P	19	3.4	−0.9	16	−3.09	0.002

12.4.4 Percentage improvement from baseline

A higher percentage of horses were reported to have improved by at least 50% from their baseline in the measures of primary importance when using the placebo headcollar compared to the magnetised headcollar, see Table 12.4. 32% of horses improved by 50% or more in *overall severity* and 42% for *vertical headshaking* when wearing the placebo headcollar. This compares to 11% for *overall severity* and 21% for *vertical headshaking* when wearing the magnetised headcollar.

Table 12.4. The number of horses (out of *N* with a score at baseline) reported to have deteriorated or improved from their own baseline score by at least 10% for *overall severity* and frequency of *vertical headshaking* when wearing the magnetised (M) and placebo (P) headcollar. Also shown is the percentage of horses (out of *N*) that were reported to have improved by 50% or more of their baseline score for each measure.

Measure	Type	*N*	Worse 10%+	No change	Improved 10%+	Improved 50% +
Overall severity	M	19	5	7	7	2 (11%)
	P	19	1	6	12	6 (32%)
Vertical headshaking	M	19	4	7	8	4 (21%)
	P	19	1	7	11	8 (42%)

With the exception of *dropping the nose to the ground*, for all of the secondary headshaking measures, a higher percentage of horses were reported to have improved by 50% or more when wearing the placebo headcollar as opposed to the magnetised headcollar, see Table 12.5. The percentage of horses that improved by 50% or more when wearing the magnetised headcollar ranged from 0% (for tendency to headshake *at rest* or *when excited*) to 38% (for *dropping the nose to the ground*). When wearing the placebo headcollar, the percentage achieving this level of success ranged from 7% (for tendency to headshake *when excited*) to 50% (for *rubbing nose on objects* and *striking at nose*).

Table 12.5. The number of horses (out of *N* with a score at baseline) that were reported to have deteriorated or improved from their baseline score by at least 10%, when wearing the magnetised (M) and the (P) placebo headcollar, for each measure. Also shown is the percentage of horses (out of *N*) that were reported to have improved by 50% or more from their baseline score.

Measure	Type	*N*	Worse 10%+	No change	Improved 10%+	Improved 50% +
Snorting or sneezing	**M**	19	6	7	6	4 (21%)
	P	17	2	5	10	6 (35%)
Rubbing nose on ground	**M**	13	3	4	6	5 (38%)
	P	13	3	5	5	4 (31%)
Rubbing nose on objects	**M**	15	4	6	5	3 (20%)
	P	16	2	5	9	8 (50%)
Rubbing nose on foreleg	**M**	18	7	7	4	4 (22%)
	P	17	3	6	8	5 (29%)
Striking at nose	**M**	12	5	1	6	2 (17%)
	P	14	1	4	9	7 (50%)
Flipping nose/top lip	**M**	15	4	6	5	2 (13%)
	P	17	3	5	9	5 (29%)
Likelihood of headshaking when:						
When excited	**M**	13	1	11	1	0 (0%)
	P	14	4	8	2	1 (7%)
In bright sunlight	**M**	20	7	9	4	3 (15%)
	P	19	1	10	8	5 (26%)
In the rain	**M**	16	3	11	2	1 (6%)
	P	14	1	8	5	4 (29%)
In the wind	**M**	19	4	7	8	4 (21%)
	P	16	2	4	10	7 (44%)
At rest	**M**	19	3	15	1	0 (0%)
	P	19	2	13	4	3 (16%)
In trigger spots	**M**	19	3	11	5	1 (5%)
	P	20	1	11	8	3 (15%)
Size of headshake	**M**	19	6	7	6	2 (11%)
	P	19	0	6	13	3 (16%)

12.4.5 Within-horse differences

There was no statistically significant difference in outcome (treatment–baseline change, *d*) between the magnetised and placebo headcollar for the two measures of primary importance; *overall severity* ($p=0.240$) and *vertical headshaking* ($p=0.360$), see Table 12.6.

Table 12.6. The results of Wilcoxon signed-rank tests of within-horse differences in *overall severity* and frequency of *vertical headshaking* (change under magnetised–change under placebo headcollar), *N*=20.

Measure	*N*	Median difference	*N* for test	*Z*, test statistic	p
Overall severity	18	+0.2	16	1.18	0.240
Vertical headshaking	18	–0.1	17	+0.92	0.360

For all the secondary measures there was either no difference between the outcome (treatment–baseline difference) of the magnetised and placebo headcollars, or the median improvement from baseline was greater under the placebo headcollar. However, for all but two measures, *size of headshake* ($p=0.007$) and frequency of *rubbing the nose on the foreleg* ($p=0.008$), none of the differences were statistically significant ($p>0.05$). There was a tendency for a difference between the headcollars with respect to outcome measure for likelihood of headshaking *in bright sunlight* ($p=0.073$) and likelihood of headshaking *in the wind* ($p=0.054$). However, given the number of tests in this section these tendencies should be treated cautiously as they may reflect type I errors.

Table 12.7. The results of Wilcoxon signed-rank tests of within-horse differences in secondary headshaking measures (change under magnetised–change under placebo headcollar), *N*=20.

Measure	*N*	Median difference	*N* for test	*Z*, test statistic	p
Snorting or sneezing	17	0.2	15	+1.54	0.123
Dropping nose to ground	10	0.0	8	–0.05	0.959
Rubbing nose on objects	14	0.3	12	1.04	0.298
Rubbing nose on foreleg	16	1.0	14	2.64	0.008
Striking at nose	10	0.2	8	1.48	0.139
Flipping nose/top lip	15	0.7	12	1.46	0.145
Likelihood of headshaking when:					
Excited	13	0.0	6	–0.77	0.441
In bright sunlight	19	1.0	13	1.79	0.073
In the rain	12	0.0	5	0.44	0.658
In the wind	16	1.5	15	1.93	0.054
At rest	19	0.0	9	0.99	0.322
In trigger spots	19	0.0	10	1.31	0.191
Size of headshake	18	1.0	17	2.70	0.007

12.4.6 Other measures of potential efficacy

12.4.6.1 Latency to headshake

At the first baseline assessment, 12 horses (60%) reportedly did not begin to headshake until after they were asked to trot (5 minutes) and 8 (40%) until at least 10 minutes into exercise. Following the application of the placebo headcollar (N=18), 7 horses increased, 9 did not change and 2 decreased in their latency to headshake. Following the application of the magnetised headcollar (N=16), 5 horses increased, 9 did not change and 2 decreased in their latency to headshake. There was no significant difference between the placebo and magnetic headcollars in whether the horse's latency to headshake increased, stayed the same or decreased (Wilcoxon signed rank test; $Z = -0.236$, N for test = 11, $p = 0.814$).

12.4.6.2 Efficacy rating

The mean efficacy rating of the magnetised headcollar, as rated by the owners, was 2.3 on a scale of 1 to 6 (SD 1.37, median 2, range 1–5, $N = 20$) and the placebo headcollar a mean of 2.9 (SD 1.87, median 2, range 1–6, $N = 20$). These scores equate to an efficacy rating of 'hard to tell' for both headcollar types (see Appendix IX for the efficacy scale in the assessment form). 20% of owners rated the magnetised headcollar to be at least 'partially effective' (a score of 4 or more) and 45% the placebo. However, there was no significant difference in the efficacy ratings of the two headcollars (Wilcoxon signed-rank; $Z = -1.34$, N for test = 11, $p = 0.179$).

12.4.6.3 Satisfaction rating

For overall satisfaction with the headcollar, the magnetised headcollar was rated a mean of 2.2 on a scale of 1 to 6 (SD 1.15, median 2, range 1–5, $N = 20$) and the placebo headcollar a mean of 2.8 (SD 1.62, median 2, range 1–5, $N = 19$). This also equates to a satisfaction rating of 'hard to tell' for both headcollars (see Appendix IX for the satisfaction scale in the assessment form). 3 owners claimed to be at least 'partially satisfied' with the magnetised headcollar and 7 for the placebo. There was no significant difference in the satisfaction rating of the two headcollar types (Wilcoxon signed-rank test; $Z = -1.61$, N for test = 8, p = 0.109).

12.4.6.4 Other comments

Some of the owners made comments regarding the differences they saw in their horse with each of the headcollars and these are summarised in Table 12.9. An approximately equal number of positive and negative comments were made regarding each headcollar.

12.4.6.5 'Which was the most effective headcollar?'

When asked following the trial which headcollar they thought was most effective, 10 chose the placebo headcollar, 5 the magnetised and 5 saw no appreciable difference.

Table 12.9. Additional comments made by the owners on the reverse of the treatment assessment form regarding the effect of the headcollar on their horse.

Comments	Magnetic	Placebo
Horse was more 'calm'	4	6
Horse was more 'lively'	1	1
Horse was more 'supple'	0	3
Improvement in headshaking seen	4	5
Deterioration in headshaking seen	4	3
Other[1]	1	0

[1] *An unrelated eye wound healed more quickly than expected*

12.5 Discussion

No evidence was found to support the hypothesis that wearing a magnetic headcollar of the kind used in the trial improved the occurrence and severity of headshaking signs as reported by the horse owner. There was no statistically significant change from baseline for the two measures of primary importance; *overall severity* or *vertical headshaking*. Although there was a tendency to report improvement rather than deterioration in the horses, many were also reported to deteriorate or not change from their baseline measure and as such the average improvement in these measures was zero. There was, however, a significant improvement in the primary measures when the horses were wearing the placebo headcollar. However, a paired comparison failed to find any significance difference in outcomes for *overall severity* and *vertical headshaking* between the magnetised and placebo headcollar.

A similar pattern was apparent in the measures of secondary importance. There was no significant improvement in any of the 13 measures when the horses were wearing the magnetised headcollar but there was statistically significant improvement in seven of the measures when the horses were wearing the placebo headcollar. A within-horse comparison found a significant difference between the headcollars for only two of these measures. Given the number of statistical tests completed in this particular study and the *a priori* definition of these measures as secondary, the apparent improvement when wearing the placebo headcollar over the magnetised for these two measures should be treated with caution. It is possible that the magnets might be exerting a negative effect on the horse's headshaking behaviour such that a placebo appears to be better, but no mechanism for this can be offered. It is more likely that the fact that more owners tested the placebo headcollar first created a tendency toward higher reporting of improvement during this first period, perhaps because the owners were more enthusiastic about the trial at the beginning.

Although the result is slightly confused by the improvement being consistently reported in the placebo treatment as opposed to the magnetic treatment, this trial demonstrates the importance of placebos. Had the placebo headcollar been the product under scrutiny, such as a magnetic headcollar with a lower magnetism, then without comparison with a true placebo, this trial may have been taken as providing evidence of the efficacy of magnatherapy at reducing headshaking. Because the improvement under each treatment type was compared within each horse, (change under magnetic–change under placebo) no evidence could be found to support the contention that either had any specific efficacy. 'Specific efficacy' is that that the treatment provides relief over and above that which might be expected to occur for a number of other reasons, including participation in a trial (McMillan 1999). No difference in primary outcome measures was found between the magnetic and placebo headcollars. This suggests that the outcome measures for both treatments reflected other factors than magnatherapy, such as the tendency of owners to report improvement and natural progression of the headshaking condition over the course of the trial. The lack of any significant, overall improvement under the magnetic headcollar also suggests that the owners remained 'blind' to the identity of the collars. Blinding is crucial if the placebo is to work as a true control (Pocock 1991).

Given that there are likely to be various causes for the headshaking in the horses used in this study, and that the use of magnetic therapy has not be fully demonstrated, this negative result is perhaps unsurprising. However, the majority of horses participating in the trial had been headshaking for a considerable length of time and were considered to be unpleasant and difficult to control because of their problem. In addition, the headcollar was worn for only 2 weeks and a longer period may have been necessary to produce a noticeable effect on the horse, although this had been agreed as an adequate time-frame by the manufacturer. Another possibility is that the magnets failed to exert their effect because of the nature in which they were applied to the horse. Ramey *et al.* (1998) found that at 1 cm from a magnetic equine leg bandage the field strength had decreased from 350 Gauss to 1 Gauss (the earth's magnetic field is approximately 0.5 Gauss). Thus, it is possible that the method of applying magnets is a useful one for this condition, but its implementation by the device used in this trial is ineffective. Reasons for this could be the distance between the magnet and the targeted blood supply or the actual positioning of the magnets on the horse's head.

Chapter 13

Part IV

Assessment of management aids for equine headshaking syndrome:

1. A double-blind, placebo-controlled, cross-over trial of an herbal supplement

13.1 Introduction

It has been reported that dietary supplements are often employed by owners for the treatment of equine headshaking syndrome (Mills *et al.* 2002b). In their survey of 245 headshakers Mills *et al.* reported that 43% of owners had tried a feed supplement and, of these, 35% reported at least partial success with it. The types of supplements that the owners reported using varied both in their content and their reported mode of action. Popularly reported supplements included vitamins, mineral supplements (e.g. magnesium for muscle and nerve function), garlic (to stimulate the immune system and circulation), and herbal supplements, including prepared mixtures or single herb products such as Echinacea. The use of prepared herbal feed supplements is particularly commonly reported by owners of horses with a headshaking problem. 59% of the horses in the Q2000 survey reported trying an herbal supplement and 43% of these reported at least partial success with it, see Table 3.8.

These products are given to the horse with the aim of reducing the headshaking signs indirectly by improving the horse's temperament (Response[1], Stresscare[2]), by protecting renal tissue from oxidative damage (D-Tox[3], Restore[2]), by providing natural pain relief (Devils' claw), or by stimulating the immune system (Echinacea). Products for the prevention and treatment of respiratory problems and allergies are particularly popular (e.g. Hackaway[1], Zephyr[2], Respiraze[3]). These tend to be purchased under the assumption that the headshaking condition is caused by a respiratory allergy, a commonly held view especially in the light of the problem's seasonal occurrence (Lane and Mair 1987).

The presence of active ingredients within herbs has long been recognised. Some Western medicines, such as digitoxin, have been derived from isolating these active ingredients from the plant, in this case, from foxgloves (Mabey 1988). However, there is increasing evidence of the effectiveness of the crude extract of single herbs in human medicine (for example, Echinacea for the common cold–Scaglione and Lund (1995) and St. John's wort for mild depression–Linde *et al.* (1996)). There are also an increasing number of studies on the efficacy of single herbal preparations on horses (for example, Echinacea to stimulate the immune system–O'Neill, *et al.* 2002). The use of single herb preparations is considered to be a Western form of herbalism (Fleming 2002). The use of several herbal ingredients to treat the patient as a whole is employed by traditional Chinese medicine (TCM). Herbs are chosen to address specific symptoms and to restore homeostasis to underlying imbalances that may have predisposed the animal to the condition to start with. In this way, TCM aims to cure the patient rather than to control the symptoms (Fleming 2002). There are reports of the efficacy of TCM over placebo for human conditions, for example, childhood bronchial asthma (Hsieh 1996). Despite the application of TCM for horses (for example, for diarrhoea–Xie *et al.* 1999), there have not been many controlled studies published regarding their efficacy at treating equine ailments. More particularly, there have been no published, controlled studies to date regarding the effects of either Western or Chinese herbal preparations on headshaking syndrome.

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[1] Hilton Herbs Ltd., Somerset, UK.
[2] Indian Herbs Equine Ltd., Wiltshire, UK.
[3] Natural Animal Feeds/Nutrilabs, Monmouth, UK

'Horsewise' Upper Respiratory Formula (LenRys Associates Ltd., Attleborough, Norfolk) is a herbal, dietary supplement that comes in the form of small biscuits, which are fed as treats to the horse. The product has been on the market for several years and has, anecdotally, dramatically reduced symptoms in seasonal headshakers. It has been formulated using TCM theory, specifically for the treatment of upper respiratory allergies and disorders in horses. It is reputed to clear the sinuses by breaking down phlegm in the upper respiratory tract and to have a 'calming effect on the liver' (LenRys promotional material). No adverse side effects have been reported at this time (Leer pers. comm.) and the ingredients have been passed as safe for horses by a veterinary surgeon (Vogel pers. comm.). The biscuits contain: organic barley flour, 100% cane molasses, pure peppermint oil, water, Chinese herbs (*Sileris*, *Codonopsis*, Mume fruit, Magnolia flower, *Bulpleurum*, Liquorice root, *Forsythia*). According to the manufacturers, a five-month course of the supplement is advised for headshakers, the final two months being a weaning dosage equivalent to one month's supply. After this, the manufacturers report that the horse may not require any further supplementation in order to prevent headshaking attacks but warn that relapse may occur if the initial 5-month course is not completed (Leer pers. comm.). Improvement in the horse's headshaking behaviour is expected to be evident within three weeks of beginning to feed the biscuits. As with similar herbal products, there has been no independent, controlled trial to establish its efficacy at reducing headshaking problems. It is important to control for any change in the horse which might occur for any reason other than the product. In this way, the specific efficacy of the product can be established, which is the change in the horse that can be attributed to the product as opposed to anything else. Controlling for these nuisance factors is best done through the use of a placebo product, which is fed to the same horse for the same period of time either before or after they had received the product in question. In this instance, a placebo supplement is easy to produce–the same biscuit excluding the herbs. As is essential to the use of placebo, the owner and other people involved in monitoring the horse and the results must remain blind to the identity of the biscuits they are feeding the horse, otherwise the 'control' is not perfect.

13.2 Aim

The aim of the study was to test the hypothesis that feeding of the Horsewise ™ Upper Respiratory herbal supplement would reduce the occurrence and severity of seasonal headshaking signs reported by the owner. This would be done by a double-blind, placebo-controlled, cross-over field trial of the supplement on a selection of horses believed by their owner to have a seasonal headshaking problem.

13.3 Trial method

11.3.1 Trial design

The trial was designed as a double-blind, placebo-controlled cross-over trial. The manufacturer produced some placebo biscuits that were identical in all aspects to the commercial product (verum) but without the Chinese herbs. Each horse was fed the verum and placebo biscuits for a period of five-weeks each with a baseline assessment period lasting two weeks (without biscuits) prior to each treatment. See Table 9.1 for a scheme of the trial. The manufacturer anticipated that horses would show substantial, if not complete, improvement within the five weeks devoted to the testing of the biscuits although the course of the treatment is usually longer (Leer, pers. comm.). Horses were typically fed 4 biscuits a day on an empty stomach as a treat. Owners with horses weighing less than 250kg were instructed to feed 3 biscuits daily and horses weighing over 500kg 6 biscuits a day.

As each horse was recruited, the owner was asked by the researcher to begin the two-week baseline assessment of the occurrence and severity of their horse's headshaking problem, as described below. In time to coincide with the ending of this period, the manufacturer sent them their first 5-week supply of biscuits (either verum or placebo). Equal numbers of horses, i.e. 15, received the verum or the placebo biscuits first. Neither the owner nor the researcher were made aware of which type of biscuit each owner had been sent first but a record was kept by the manufacturer. Instructions as to the feeding of the biscuits were included with the biscuits. After the feeding of the first supplement had come to an end the owners were instructed via written and telephone instruction to begin another two-week 'washout' period, when no supplement would be given. The delivery of the second supplement to the owner was timed so as to coincide with the end of this washout period.

13.3.2 Assessment

As a consequence of the much longer time-frame necessary for this trial, owners were sent a single form, which they were asked to complete at the end of each week of the trial regarding the occurrence and severity of their horse's headshaking symptoms, see Appendix X. In this way it would be possible to assess the likely time by which any improvement became apparent to the owner and reduce the paperwork for the owners. The number of measures the owners were asked to observe was also reduced in order to encourage compliance. The owners were asked to rate the occurrence of the same seven headshaking signs that were assessed in the other trials and the *overall severity* of the condition during typical exercise each week. The occurrence of any *nasal discharge* was also included as a measure since the manufacturer believed the supplement would also have an effect on this. As in the previous trials, *overall severity* and occurrence of *vertical headshaking* were the *a priori* defined measures of primary importance.

Instead of placing a mark along the seven-point scale as in the previous trials, the owners were asked to score the occurrence of each of the headshaking signs during a typical ride each week from 0–6 according to the scale below:

Vertical headshaking	0	1	2	3	4	5	6
	never		occasional		frequent		continual

The owners were asked to rate the *overall severity* of the headshaking and its associated symptoms in the same way but this time the scale was marked with 'absent', 'quite mild', 'quite severe' and 'very severe'.

Scores during the final week of the baseline period (Week 2) and the washout period (Week 9) were used as the two baseline scores and the final week of each treatment period (Week 7 and Week 14) were used as the treatment score, see Table 9.1. The final week of each baseline or treatment period was compared (treatment-baseline) as the outcome measure for each treatment. The final weeks of each period were chosen in order to maximise any potential difference between baseline and treatment score. A comparison of these outcome measures was then made between verum and placebo (verum-placebo) in order to establish the average improvement in the horses with verum treatment over and above that obtained with the placebo. To identify the order in which the supplements had been tested by each horse, and therefore which weeks to use for each treatment type, whilst remaining blind to their identity, the supplements were recorded by the manufacturer as A and B. Only when the analyses had been completed did the researcher request the composition of A and B.

13.3.3 Trial dates and participants

151 owners from the NEHS database with horses that were still available for further study were contacted in May 2002 with an invitation to participate in the study, providing the horse fulfilled the selection criteria listed below. Horses were selected if their owners replied positively to the invitation until the quota of 30 horses had been recruited (see Section 9.6.4 for a justification of this sample size). The trial commenced between 1st June and 1st July 2002 as horses became available. Allocation to the trial was made at random, without a probabilistic design, in groups of 2 horses at a time, although start dates did depend on the availability of the horse and its owner. Allocation to test either the verum or placebo supplement first was done at random by the manufacturer tossing a coin.

13.3.4 Additional selection criteria

The supplement was expected to be efficacious for the treatment and prevention of respiratory allergies. Since the manufacturer considered that horses with a seasonal component to their problem would be more likely to be headshaking because of some kind of respiratory allergy, only seasonal headshakers were included on the trial. To this effect, specific inclusion and exclusion criteria were added to the trial protocol described in Section 9.6.2 and are described below:

13.3.4.1 Inclusion criteria

- The headshaking problem was seasonal, in that the horse suffers during the spring and summer months and only minimally, if at all, in the autumn and winter
- The horse was reported to show other symptoms such as excessive snorting or sneezing and excessive rubbing of the muzzle
- The owner believed the horse's symptoms deteriorated in warm, dry conditions
- The owner believed the horse's symptoms were relieved in wet weather
- The owner believed that the cause of the problem might be an allergy to pollen or grasses

13.3.4.2 Exclusion criteria

- Horses that were currently receiving veterinary medication for headshaking
- Horses that received any other dietary supplements, including herbal supplements and garlic during and up to 2 weeks prior to the onset of the trial

13.3.5 .Additional questions to the owners

Following the end of the treatment period for each supplement, the owners were asked via telephone:

1. To rate the supplement for alleviating their horse's headshaking symptoms on a scale of 1 to 6, 1 being 'totally ineffective' and 6 being 'extremely effective'.

2. To quantify as a percentage the change they saw in their horse's symptoms from baseline, i.e. were they 50% better, etc?

3. Whether they would like to receive another month's free supply of the genuine product in appreciation of their participation in the trial.

13.4 Results

13.4.1 Basic characteristics of horses in the trial

30 horses were recruited onto the trial. However, one withdrew 4 weeks into the trial due to unrelated circumstances, too late to recruit another horse in its place. Another owner completed the trial but failed to return the assessment form within a reasonable time. Thus, results were available from 28 horses in all, 14 receiving verum first and 14 receiving placebo first.

Table 13.1 lists the basic characteristics of the horses participating in the trial. A range of breeds and ages were represented. Most horses were geldings, were used primarily for pleasure and had had the problem for a number of years. 82% of the horses had a headshaking problem that the owner considered to be at least 'unpleasant' when at its worst. All horses had a sunny seasonal component to their problem, 21% were reported to still suffer minimally in the winter, the remainder being unaffected.

There were no significant differences between the two allocation groups (verum or placebo tested first) with respect to sex, breed, use, severity rating or seasonality (Fisher's exact test, p-value>0.05). Neither was there any significant difference between the two groups with respect to age (Wilcoxon rank-sum test; $Z = 0.07$, N for test = 14, 14, p = 0.945) or number of years known to be a headshaker at the start of the trial (Wilcoxon rank-sum test; $Z = 0.41$, N for test = 14, 14, p = 0.679).

Table 13.1 The basic characteristics of the horses participating in the trial of the Horsewise™ Upper Respiratory herbal feed supplement.

Characteristic	Trial participants
Number of horses on trial	29 (complete records available for 28)
Sex	21 geldings (75%), 7 mares
Breed type	10 thoroughbreds, 7 cobs, 4 ponies, 7 others, no warmbloods
Use	23 primarily pleasure 5 affiliated/professional competition
Age	Mean 12.25 years, SD 3.25 years Median 12 years, Range 7–21 years old
Seasonality of headshaking	20 sunny seasonal 6 perennial with seasonal exacerbations
Severity rating of headshaking	0 (barely noticeable), 5 (bearable) 13 (unpleasant), 10 (unrideable)
Known to be headshaking for (to nearest ¼ year)	Mean 4.75 years , SD. 2.75 years Median 4.25 years, Range 1–11.5 years

13.4.2 Conditions during the course of the trial

The horses were exercised 3.8 times a week on average over both baseline and treatment final weeks (SD 1.4, median 3.75, range 1–7, N = 28). There was no significant difference in the amount of exercise undertaken weekly on the final week of treatment between the verum and placebo supplements (Wilcoxon signed-rank test, $Z = -0.67$, N for test = 17, p = 0.500).

There were no significant differences in the baseline headshaking measures prior to feeding the verum supplement and the placebo (Wilcoxon signed rank, p>0.05 for all measures).

13.4.3 Treatment–baseline difference in headshaking

There was a statistically significant improvement in score for *overall severity* ($p<0.001$) and frequency of *vertical headshaking* ($p = 0.002$) after five weeks of the verum supplement, see Table 13.2. However, there was also a statistically significant improvement in *overall severity* ($p = 0.006$) and frequency of *vertical headshaking* ($p = 0.005$) after five weeks of the placebo supplement. The median change in both measures for both supplements was an improvement by one point on the seven-point scale.

Table 13.2. The median score for *overall severity* and frequency of *vertical headshaking* at baseline (out of *N* horses with a score) and the median treatment–baseline difference, *d*, for the verum (V) and placebo (P) supplement. Also shown are results from Wilcoxon signed-rank tests of the significance of the difference of *d* from zero for each measure (Test statistic, *Z*, *N* for test and p-value).

Measure	Type	*N*	Median baseline score	Median change, *d*	*N* for test	*Z*, test statistic	p
Overall severity	V	27	3	–1	20	–3.58	<0.001
	P	27	4	–1	23	–2.74	0.006
Vertical headshaking	V	26	3	–1	16	–3.06	0.002
	P	26	4	–1	24	–2.83	0.005

There was a statistically significant improvement in six of the seven secondary headshaking signs after supplementation with verum, see Table 13.3. There was only a trend for improvement in *nasal discharge* with the verum supplement ($p=0.085$). The median improvement was by 1 point for all signs with the exception of *dropping the* *nose to the ground* (2 points) and *nasal discharge* (0 points). There was also a significant improvement under the placebo treatment for six of the seven signs, including *nasal discharge* (p = 0.006). The median improvement for each sign had a similar magnitude to that reported with the verum.

Table 13.3. The median score at baseline for each of the headshaking measures (out of *N* horses with a score) and the median treatment–baseline difference, *d*, for the verum (V) and placebo (P) supplement. Also shown are results from Wilcoxon signed-rank tests of the significance of the difference of *d* from zero for each measure (Test statistic, *Z*, *N* for test and p-value).

Measure	Type	*N*	Median baseline score	Median change, *d*	*N* for test	*Z*, test statistic	p
Snorting or sneezing	V	26	3	–1	20	–2.97	0.003
	P	24	2.5	0	19	–0.42	0.672
Dropping nose to ground	V	13	3	–2	11	–2.78	0.005
	P	16	2	–1.5	12	–3.29	0.001
Rubbing nose on objects	V	24	2	–1	17	–2.92	0.004
	P	23	2	–1	18	–3.37	<0.001
Rubbing nose on foreleg	V	26	3	–1	18	–3.38	<0.001
	P	25	2	–1	20	–3.64	<0.001
Flipping nose/top lip	V	14	3	–1	10	–2.00	0.045
	P	16	2	–1	14	–2.54	0.011
Striking at nose	V	15	2	–1	13	–2.16	0.031
	P	13	4	–2	11	–2.79	0.005
Nasal discharge	V	18	2.5	0	11	–1.73	0.085
	P	17	3	–1	16	–2.78	0.006

13.4.4 Percentage improvement from baseline

67% of horses were reported to improve in *overall severity* and 58% in frequency of *vertical headshaking* after five weeks of receiving the verum supplement, see Table 13.4. However, 67% were also reported to improve in *overall severity* and 77% in *vertical headshaking* after being fed the placebo supplement. 33% of horses were reported to have improved by at least 50% from their baseline score in *overall severity* after supplementation of the verum supplement. A similar percentage, 26%, was reported to improve by this level in *overall severity* after supplementation with placebo. For frequency of *vertical headshaking* 23% of horses were reported to have improved by at least 50% under verum compared to 50% under placebo treatment.

Table 13.4. The number of horses (out of *N* with a score at baseline) reported to have deteriorated or improved from their own baseline score by at least 10% for *overall severity* and frequency of *vertical headshaking* after five weeks of the verum (V) and placebo (P) supplements. Also shown is the percentage of horses (out of *N*) that were reported to have improved by 50% or more of their baseline score for each.

Measure	Type	*N*	Worse 10%+	No change	Improved 10%+	Improved 50% +
Overall severity	**V**	27	2	7	18	9 (33%)
	P	27	5	4	18	7 (26%)
Vertical headshaking	**V**	26	1	10	15	6 (23%)
	P	26	4	2	20	13 (50%)

Improvement by at least 50% in the secondary signs after five weeks of feeding the verum supplement ranged from 27% for frequency of *nasal discharge* to 77% for *dropping the nose to the ground*. However, a similar percentage of horses were reported to improve by this extent after five weeks of the placebo treatment. A slightly higher percentage of horses were reported to have improved by at least 50% under the verum treatment compared to placebo for the signs *snorting or sneezing* and *dropping the nose to the ground.* For the remaining five signs the converse was true.

Table 13.5. The number of horses (out of *N* with a score at baseline) reported to have deteriorated or improved from their own baseline score by at least 10% after five weeks of the verum (V) and placebo (P) supplements for each measure. Also shown is the percentage of horses (out of *N*) that were reported to have improved by 50% or more of their baseline score for each.

Measure	Type	N	Worse 10%+	No change	Improved 10%+	Improved 50% +
Snorting or sneezing	V	26	4	6	16	8 (31%)
	P	24	9	5	10	6 (25%)
Dropping nose to ground	V	13	1	2	10	10 (77%)
	P	16	0	4	12	12 (75%)
Rubbing nose on objects	V	24	2	7	15	12 (50%)
	P	23	2	5	16	12 (52%)
Rubbing nose on foreleg	V	26	2	8	16	13 (50%)
	P	25	2	5	18	13 (52%)
Flipping nose/top lip	V	14	2	4	8	6 (43%)
	P	16	2	2	12	9 (56%)
Striking at nose	V	15	3	2	10	10 (67%)
	P	13	1	2	10	9 (69%)
Nasal discharge	V	18	3	7	8	5 (27%)
	P	17	3	1	13	7 (41%)

13.4.5 Within–horse differences

There were no statistically significant differences between outcomes (treatment-baseline) for the two supplements for any of the headshaking measures including the measures of primary importance: *overall severity* and *vertical headshaking*, $p>0.05$, see Table 13.6. As a result, there was no evidence to support the contention that the verum supplement was more effective than the placebo at reducing any of the listed signs of headshaking syndrome, nor overall severity of the problem.

Table 13.6. The results of Wilcoxon signed-rank tests of within-horse differences in all headshaking measures (change in headshaking under verum–change in headshaking under placebo), *N*=28.

Measure	*N*	Median difference	*N* for test	*Z*, test statistic	p
Overall severity	26	0.0	22	0.00	1.000
Vertical headshaking	24	+0.5	19	+1.11	0.267
Snorting or sneezing	22	-1.0	18	-1.44	0.149
Dropping nose to ground	10	+0.5	9	+0.41	0.681
Rubbing nose on objects	21	0.0	13	+0.85	0.398
Rubbing nose on foreleg	23	0.0	17	+0.57	0.565
Flipping nose/top lip	9	0.0	7	+0.06	0.952
Striking at nose	7	0.0	5	–0.78	0.438
Nasal discharge	9	0.0	6	0.00	1.000

13.4.6 Other measures of potential efficacy

13.4.6.1 Efficacy rating

The mean efficacy rating of the verum supplement, as rated by the owners over the telephone, was 3.2 on a scale of 1 to 6 (SD 1.61, median 3, range 1–6, $N = 29$) and for the placebo supplement a mean of 3.1 (SD 1.53, median=3, range 1–6, $N = 29$). Both supplements therefore received an average rating that equated to 'slightly effective'. There was no statistically significant difference between the verum and placebo supplement in the efficacy rating given by the owners (Wilcoxon signed-rank; $Z = 0.00$, N for test = 23, p = 1.00). 11 (38%) owners gave the verum supplement a score of 4 or higher ('partially effective') and the same number, though not necessarily the same owner, did so for the placebo.

13.4.6.2 Estimated percentage change in symptoms from baseline

The mean percentage change in symptoms from baseline as assessed by the owners for the verum supplement was 33.0% (SD 36.26%, median 30%, range -33%–100%, $N = 29$) and for the placebo supplement was 31.2% (SD 40.24%, median 30%, range –100%–100%, $N = 29$). 11 (38%) owners judged their horse to have improved by 50% or more when using the verum supplement and 10 (34%) for the placebo. 11 (38%) owners claimed to have seen no change in their horse's symptoms when using the verum supplement and 8 (28%) when using the placebo. One horse under each treatment type was reported to have deteriorated (though this was not attributed to the treatment in question).

13.4.6.3 Other comments

All but one of the participants indicated that they would like to receive another month's supply of the commercial product for free (some decided to use it the following spring), although this was offered before the identity of the treatments was disclosed to them.

No adverse side-effects were reported apart from one episode of diarrhoea during feeding of the verum supplement which was not attributed to the biscuits.

Some comments were made on the assessment form. One owner noted that her horse was much less prone to receiving insect bites during the trial (no particular supplement identified) and one that her horse was calmer (no particular supplement identified). One owner reported that her horse's coat was much improved (less greasy) and another that her horse was less agitated and itchy (both whilst feeding the placebo supplement).

A total of seven owners reported that they felt there was a difference in either the palatability or the appearance between the two supplements. Five noted that their horse found one more appetising than the other (four felt the placebo was more appealing) and four commented that what turned out to be the verum supplement smelt distinctly more 'herby'.

13.5 Discussion

Owners reported a statistically significant improvement from baseline in *overall severity* and *vertical headshaking* after five weeks of supplementation with the verum biscuits. Median improvement was by one point on the seven-point scale. 67% of horses were reported to improve in *overall severity*, 33% by 50% or more from their baseline score. 58% of horses were reported to have improved in *vertical headshaking* and 23% by 50% or more from their baseline score. However, similar reports were made for the period in which the horse received the placebo biscuits. As a result there was no significant difference between verum and placebo in the reported improvement from baseline for *overall severity* or *vertical headshaking*. Similar levels of improvement were reported between verum and placebo for the secondary headshaking measures such that there was also no significant improvement over placebo for any of these, including *nasal discharge*, which was particularly expected to show an effect. Therefore, it cannot be concluded that the verum formula was more effective than placebo at reducing the symptoms of headshaking, at least over a five-week period.

Verbally, following the trial, the owners expressed their view that their horse had improved by around 30% on average when using either supplement. This level of improvement was mirrored by the results from their written assessment. The majority of signs were given an average score of around 3 out of 6 at baseline and improved by an average of 1 point, giving an average improvement of around 30% for both supplements. This suggests that owners have a tendency to report some improvement in their horse both verbally and via written assessment regardless of the treatment applied. The consistency with which the owners did this resulted in highly significant improvements in most signs during supplementation with both placebo and verum. Owners also attributed improvements to other aspects of their horse's condition, for example, an improvement in coat condition was reported during the feeding of what turned out to be the placebo supplement. This demonstrates the importance of using a placebo, since without one these improvements may have been attributed to the treatment.

Comparison against placebo, i.e. an inactive substance, allows the specific efficacy of the treatment to be estimated. That is, the efficacy that can be attributed to the treatment and nothing else. There are a number of factors that might explain the significant improvement with placebo treatment that was reported in this trial, all relating to the effect of participation in the trial and what is generally known as 'the placebo effect'. These factors may include the natural progression of the condition over the course of the trial and the tendency for owners to report some improvement regardless of the treatment applied. The fact that consistent improvement was reported under placebo sheds doubt upon the findings from other case studies (e.g. Mair *et al.* 1992, Mair 1999) and reports from owners regarding treatment (e.g. Madigan and Bell 2001, Mills *et al.* 2002a) since in the absence of placebo controls these improvements may not have been related to the specific action of the treatment in question. If a placebo control is to be effective, 'blinding' of the patient and the reporter of any change to the true identity of the treatment applied is crucial. In this case, the comments regarding the more 'herby' smell to the verum biscuits (4 comments) may suggest that the owners were not completely blind to the identity of the treatments. However, given the lack of significant difference between the treatment types, this either was not the case or it did not significantly increase their tendency to report improvement for the verum.

An improvement in the symptoms was expected to occur between 3 and 21 days of supplementation and was expected to increase throughout the course of the supplement (Lenrys promotional literature). The manufacturers claimed that a significant (if not complete) improvement would be identified within the five-week period of supplementation. It may be that longer than five weeks of supplementation is needed to experience an improvement greater than that of placebo. However, given the seasonal nature of the headshaking problem, a within-subject controlled trial could not have extended much longer than the present trial. The negative finding from this trial does however raise the possibility that the improvement reported to be evident by the end of the course might have more to do with the placebo effect and the natural progression of the condition towards the end of the summer, rather than any specific effect of the supplement. This might explain the apparent disparity between the popularity of supplements such as these with owner of headshakers and the lack of scientific evidence to suggest that headshaking in the majority of cases is caused by respiratory allergy. However, given our poor understanding of the causes of headshaking, the results from this trial cannot be taken as evidence to suggest that the supplement is ineffective at alleviating respiratory allergies. And, since, to date, there is little scientific evidence regarding the efficacy of the supplement in alleviating equine respiratory allergies in general, the lack of evidence of its efficacy at reducing the signs of headshaking from this trial also cannot be used as evidence to suggest that headshaking is not caused by a respiratory allergy.

The improvement reported following the feeding of the verum supplement cannot be attributed to specific action on the part of the supplement since a similar level of improvement was reported to occur following feeding of the placebo. The importance of this finding, its consequence for the results from trials that have not been controlled by placebo and the extent to which the 'effect of participation' might be influenced by the use of placebo will be discussed further in the next chapter.

Chapter 14

Discussion

14.1 Risk factors for headshaking

A range of risk factors have been mentioned in the literature with regards to headshaking syndrome, including the sex, breed, use, health and management of the horse. However, the case-control study described in Chapter 2 did not find any evidence of an association between the use, health or management of the horse and being reported to have a headshaking problem. Although the size of the sample (83 headshaker-control pairs) was relatively small, highly significant, proximate risk factors might still have been expected to emerge. A comparison of the distribution of the sexes amongst a sample of headshakers and horses from the same yard failed to find any evidence that males were more likely to be reported to be headshakers (see Chapter 4). It was also suggested in this chapter that the proportion of thoroughbreds typically observed in studies of headshakers is no larger than that reported in the general population. It was argued in Chapter 4 that the apparent bias towards geldings and use for dressage might be more a reflection of the effect of headshaking on the owner rather than potential risk factors. It was argued that since males tend to be favoured for competition (Murphy *et al.* 2004) and that headshaking appears to have most impact on the ability to perform in dressage (at least at the amateur level–see Chapter 3) this would explain their apparent dominance in either a referral case load or a self-selected questionnaire.

McGreevy *et al.* (1995) compared the reported prevalence of various equine behaviour problems across the specific professional disciplines. This method was not attempted for headshaking since it is likely to be selected against in these populations.

Headshaking is more likely to negatively impact on the performance of the horse than any stable vice such as weaving or cribbing. The hypothesis that there is a difference in prevalence between the disciplines of dressage and horse racing, for example (Mills, pers. comm.) remains untested. The apparent, relative absence of the syndrome in race horses, however, may have more to do with their age, since racehorses tend to be younger than the average age for reported onset of the problem, see Chapter 3. Other potential risk factors for headshaking were suggested by the owners in the survey described in Chapter 3 and in Mills *et al.* (2002a). These included changes in work, vaccination schedule, location and management of the horse prior to onset of the problem. There may be a need for additional case control studies concerning these factors, although the sample size would need to be larger than the one conducted in Chapter 2 in order to have confidence in the power to detect a difference in these factors between normal and headshaking horses.

14.2 Presentation of the syndrome

The survey described in Chapters 3–5 has provided possibly the most detailed information of the presentation and history of horses with an apparent headshaking problem to date. In order to more completely describe the syndrome, horse-owners were asked to select from an extensive list of signs collated from headshaking reports in the veterinary literature. As a result of this and observations from their videos, the general presentation of the syndrome was described in the form of an ethogram. 78% of the horses in the survey were reported with vertical headshaking, snorting and rubbing the nose (and 96% at least two of these signs). Madigan and Bell (2001) concluded that if horses were reported with two or three out of; headshaking, acting like bee flew up the nose and rubbing the nose, a differential diagnosis of idiopathic headshaking should be considered. The presentation of the signs of the horses described in Chapter 5 would support this suggestion, perhaps with the inclusion of excessive snorting as another important sign. This provides evidence additional to the studies of Lane and Mair (1987), Madigan and Bell (2001) and Mills *et al.* (2002a) that these signs represent the main elements of the syndrome as it appears amongst horses with a general headshaking problem. The reported prevalence of other signs such as excessive blinking, clamping the nostrils or staring into space was low, suggesting that these signs do not form a significant part of the syndrome.

In Chapter 5, principal component analysis of the reported presence of 27 signs in 200 horses differentiated between those with a typical presentation (described above) and those with other, relatively infrequently reported signs, but this distinction was not clear. Even though more information was added to the dataset, the technique appeared to be less promising at differentiating between headshaker types than the one described in Mills *et al.* (2002a). Many of the signs listed in the revised survey represented varying behavioural and physiological responses to naso-facial irritation, for example: striking at the face, dropping the nose to the ground and presence of a nasal or ocular discharge. If the cause of the expression of each behavioural sign has less to do with different locations of the irritation and more to do with random factors such as the character of the horse, then this finding may not be surprising.

In addition, in Chapter 5, the reported presence of the main signs and a score for severity and seasonality of the problem were evaluated for their ability to predict the reported response to a nose net. None of the factors included in the ordinal logistic regression model were significant. This may have been because the factors chosen were genuinely not predictive for the reasons mentioned above. However, the failure of the horses' symptomatology to predict the response to a nose net may have been because it has a more general effect on all kinds of headshakers, for example by providing a distracting or counter stimulus, as suggested by Mills *et al.* (2002a). There are other techniques for identifying prognostic factors such as classification and regression trees (Chae *et al.* 2001) and neural networks (Drew *et al.* 1999). However, without more information regarding likely prognostic factors and results from successful treatments, these are also unlikely to be very informative and reliable at this stage. As a result, an attempt was made to evaluate the efficacy of various therapies with a potentially more selective mode of action. It was anticipated that successful reduction of headshaking signs with these might indicate likely prognostic factors.

14.3 Trigger factors and their implications for aetiology

In the survey described in Chapter 3, the owners reported the occurrence of the headshaking throughout each month of the year. As a result of their reports, 97% of the horses could be described as sunny seasonally affected, perennially affected with seasonal exacerbations or perennially affected. These categories have also been described for rhinitis in humans (Sibbald and Rink 1991) and as such might support the suggestion that the horses are suffering from a similar problem. Perennial headshakers were rarely reported (10% of the sample), implying that most owners attributed some variation in the headshaking to the seasons. It remains to be established, however, whether the seasonality of the headshaking attacks is being accurately reported by the owners. There was no evidence to suggest that the occurrence of headshaking varied with the workload of the horse, since the latter was reported to remain constant throughout the year. This result would not support the contention by Cook that headshaking only appears more apparent over the summer because the horse tends to be ridden more over this period (Cook 1992).

It is not known whether the seasonal types represent a severity gradient within a single condition or different conditions. There were few differences between the seasonality types, either in reported response to certain trigger situations or the prevalence of signs. However, horses with a less defined seasonal component were more likely to be reported with signs such as *flipping the nose*, *clamping the nostrils* and *striking at the nose* and were more likely to shake *in the rain* or *when excited* or *nervous*. This might indicate that they have a specific irritation focused at the end of their muzzle or that they are more severely affected. There are some similarities here with human rhinitis, in which the main signs of sneezing and runny nose were similarly reported between the three seasonality types, although perennial sufferers were more likely to be triggered by changes in emotion (Sibbald and Rink 1991). Cook (pers. comm.) suggests that the seasonality is a reflection of the same disease process with different temporal manifestations, depending on which branches of the trigeminal nerve are involved. These differences in the presentation of the perennial condition compared to the seasonal condition might support the contention by von Schweinitiz (cited by Scott

2001) that some headshakers have post herpetic neuralgia, which presents itself as general hypersensitivity to touch and wind that is less spasmodic than trigeminal neuralgia.

The variety of signs of nasal irritation that tend to accompany the problem and the intermittency of its occurrence suggest that the problem has some clinical cause as opposed to a purely psychological one. The intermittency of the problem has been demonstrated in the reports of owners (Chapter 3), in a comparison between a single exercise session and an assessment based on recall (Chapter 8) and from the reports of spontaneous improvement under placebo treatments (Chapters 12 and 13). Intermittency is consistent with various forms of facial neuralgia, which are typically intermittent with period of remission (Rasmussen 1990), as well as with rhinitis. The apparent seasonality of the condition could also be consistent with the presence or absence of trigger factors for both rhinitis and neuralgia. Typical trigger factors for trigeminal neuralgia are wind, cold weather and chewing (Rasmussen 1990). However, these were not commonly reported by owners in the survey described in Chapter 3, nor in other surveys (Lane and Mair 1987, Mills *et al.*, 2002a, Madigan and Bell 2001). Horses with an all year round problem were rarely reported in the survey in Chapter 3, which might suggest that horses with a persistent clinical problem, such as otitis media/interna are rare. [However, within any sample of headshakers the incidence of this problem has not been reported for which the diagnosis has been established by the correct techniques. Blythe *et al.* (1990) argued that headshaking can be an early sign of otitis media/interna prior to facial nerve dysfunction and that tympanocentesis is the best method of detecting the infection behind the tympanic membrane at this stage. However, this method has not been reported in any of the referral samples to date.]

A trial of the bitless bridle advocated by Cook (1998a) was described in Chapter 10. 27 horses were ridden in the bridle for a period of two weeks. There was some evidence of improvement in overall severity, with over 50% of horses being reported to improve in this measure, but the average size of the improvement was small. Table 14.1 summarises the results from this and the other trials conducted as part of the larger study.

Table 14.1 The percentages of horses improving in *overall severity* and frequency of *vertical headshaking* for the trials under discussion. *N* indicates the number of horses used in each measure. Significance of the change from baseline is indicated below the percentage of horses improving and corresponds to p-values: * $p<0.05$, ** $p<0.01$, *** $p<0.001$, NS: not significant, $p>0.05$. The results from Mills and Taylor (2003) are included for comparison; Half (B) and Full refer to the types of net used in the trial, not placebo.

Device (chapter)	Primary Indication	Type of trial	N	Measure	% horses improved		% horses improved by 50%		Sig. of within-horse comp.
Bitless bridle (Chapter 10)	Pain caused by bit	Simple field	27	Overall severity	52% *		19%		-
			27	Vertical headshaking	41% NS		22%		-
Light-limiting face mask (Chapter 11)	Photic reaction	Simple field	22	Overall severity	45% NS		14%		-
			22	Vertical headshaking	41% NS		23%		-
					Verum	Placebo	Verum	Placebo	
Magnetic headcollar (Chapter 12)	Nerve/muscle pain	Placebo controlled cross-over	19	Overall severity	37% NS	63% **	11%	32%	NS
			19	Vertical headshaking	42% NS	58% **	21%	42%	NS
Herbal supplement (Chapter 13)	Upper respiratory allergy	Placebo controlled cross-over	28	Overall severity	68% **	70% ***	36%	30%	NS
			27	Vertical headshaking	59% **	78% ***	26%	52%	NS
					Half (B)	Full	Half (B)	Full	
Nose net (Mills & Taylor 2003)	Nasal irritation	Repeated measures (Scale 1–5)	36	Overall severity	76% ***	68% ***	58%	59%	NS
			35	Vertical headshaking	69% ***	65% ***	50%	56%	NS

Nearly 40% of horses in the survey described in Chapter 3 were reported to improve when lunged, although this may have more to do with the absence of triggers in the lunging area than the absence of the bit. Very few horses were reported to resent being bridled, which might have suggested that the horse associated being bridled with pain. These findings appear to be in contrast to the report by Cook (2003) in which 46 horses apparently ceased to headshake when ridden in the bridle. A more controlled study of the bitless bridle may be a consideration in the future but, in UK horses at least, exercise without bit appears to be of limited clinical significance. It remains to be established, however, whether the use of the bit triggers the initial onset of the headshaking problem.

Despite consistent reports by owners that the horse is worse on bright, sunny days (see chapter 3), a two-week trial of a light-limiting facemask on 22 horses failed to produce any evidence of a significant reduction in headshaking signs (see Chapter 11 and Table 14.1). This is in compete contrast with reports of headshakers in the USA. Madigan and Bell (2001) suggested that the clinical signs of horses with a photic component were no different to those not apparently affected by light. A comparison of the details between the horses in their study that responded to blindfolding with those in this study supported their contention (see Chapter 11). However, there was some evidence to suggest that, whilst the prevalence of main signs of the syndrome did not differ between horses that did not respond to covering the eyes and those that did; those that did respond were more likely to be reported to be affected only over the sunnier months and at rest. These factors would be consistent with the hypothesis that sunlight was the trigger for the headshaking and might be used to identify horses that are likely to benefit from protection of the eyes from the sunlight. However, the association is not likely to be a very close one since many of the horses in the trial described in Chapter 11 were reported to be seasonal and affected at rest. The association with bright, sunny days did not appear to be predictive of success with the face mask which suggests that in UK horses there is some other factor associated with this situation that triggers the headshaking. Maybe sunlight is less significant in UK horses because it is generally of a lower intensity and duration in the UK compared to the USA. Alternatively, owners are mistaken and the association is a myth. It would be interesting to design a study to test this hypothesis. The results from both field studies support the theory that headshaking is the result of irritation that can be caused by several different factors.

The findings from the two simple field trials, described in Chapters 10 and 11, may be seen to support the theory by Newton *et al.* (2000) that the source of the irritation is more likely to lie primarily within the nasal cavity as opposed to referred from the ophthalmic (i.e. from light) or mandibular branches (i.e. from the pressure of the bit). A priority may now be to establish the mechanism of action of the occlusive mask (Newton *et al.* 2000) and the nose net (Mills and Taylor 2003, see summary of results in Table 14.1), which have both recently been demonstrated to be very effective at reducing headshaking. Multivariate techniques used to classify the headshakers using survey data in Chapter 5 suggested that a nose net was reported to be most successful on horses that displayed typical, mild, seasonal symptoms. This might imply that the nose net is most helpful in milder cases. But, whether this is because it acts as an incomplete filter of irritants, improver of laminar airflow or a distractive stimulus that is not strong enough to reduce signs in more severe headshakers is not known.

14.4 Owners as assessors of headshaking signs

In the survey described in Chapters 3–5, owners were used to present the horse, i.e. to make the diagnosis of headshaking themselves. This raises the question of whether the horses included in the survey would be considered to be headshakers by a veterinary surgeon. There are a number of findings that support the hypothesis that they would, which maintains the use of surveys to describe headshaking behaviour. Firstly, the diagnosis of headshaking behaviour is reported to be relatively simple (Wilkins 1997). This is supported by the suggestion by Madigan and Bell (2001) that if the horse shows two or three signs of the mains signs; headshaking, acting like bee flew up the nose and rubbing the nose, then idiopathic headshaking should be considered. The agreement between the owners and a trained observer of the presence of some of these signs during a lunging exercise suggests that their recognition of these is as good as the trained observer (see Chapter 8). Secondly, the similarity in presentation of the syndrome between the horses in the survey described in Chapter 5 and those from referral studies such as Lane and Mair (1987) and Madigan and Bell (2001) supports the assertion that they would also be classed as 'headshakers' by a veterinary surgeon (see Chapter 4). Thirdly, a comparison of the presentation of the condition in the horses within the survey described in Chapter 5 found few differences in the reported prevalence of the major signs of headshaking between those that had been treated by a veterinary surgeon for headshaking and those that had not. Fourthly, selection criteria were applied to the survey respondents and horses were only included if they were reported to repeatedly shake or twitch their heads when being ridden, which is a behaviour consistent with the general use of the term 'headshaker' (see Section 3.3.2). The fact that none of the horses had to be rejected based on this exclusion criterion suggests that owners do not confuse between a horse with a headshaking problem at exercise and one that repeatedly shakes when stabled (a 'nodder', for example, see Cooper *et al.* 2000). In addition to this, a comparison of the prevalence of headshaking signs between horses considered by their owner to have a headshaking problem, with those that were not, was made in Chapter 2. The absence of reports of headshaking signs in normal horses suggests that these signs are recognised as part of the headshaking syndrome. Finally, in the exercise described in Chapter 6, whilst owners were in some disagreement as to whether a horse acted 'like a headshaker' from a one-minute, randomly selected video clip, they were able to consistently identify horses that would not normally fit the headshaker description. Since many of the major signs of headshaking were absent on some of the video clips it is likely that a veterinary surgeon would also struggle to make the decision that the horse had acted like a headshaker.

The survey described in Chapter 5 and the subsequent trials (Chapters 10–13) made use of the reports of owners rather an independent professional or other objective measure of the headshaking. An argument to support their use was put forward based on two main observations. Firstly, an evaluation of the consistency of their reports was made via a video observation exercise, described in Chapter 6. Both the consistency of their observations on repeat viewings of the same clip (intra-observer consistency) and between the owners (inter-observer consistency) was generally high. Signs chosen for subsequent analysis in trials were those for which at least 75% agreement was demonstrated (see Section 9.7). Secondly, in Chapter 8, significant disagreement within owners between a single observation of their horse and a survey based on their recall was reported regarding the presence of many of the headshaking signs. This discrepancy between 'real life' and a snapshot of the horse's behaviour was also mirrored in the videotape exercise described in Chapter 8. Many of the important headshaking signs, e.g. striking out and rubbing the nose, were absent from randomly selected clips of horses demonstrating headshaking behaviour. The clarity of the various forms of headshaking also made it difficult for the owners to be consistent at reporting these. These results led to the suggestion that a single observation of the horse was likely to be unrepresentative of the true extent of the horse's current problem. The intermittency of the problem means that assessment of the horse, particularly for the evaluation of treatments for the headshaking, must take place over several occasions in order to be reliable. It was argued that owners themselves are in the best position to observe their horse on several occasions and to assess the overall severity of their problem over a period of time. Semi-objective assessment of the horse such as an independent person counting headshakes is unlikely to improve on this reliability since the 'real life' severity of the headshaking and all its associated signs at times other than the assessment period would not be taken into consideration. It was also considered too difficult to distinguish headshake 'events' from 'bouts' or 'states' of headshaking (pers. obs.).

Perhaps as a result of these difficulties, many reports of treatment currently in the veterinary literature have relied on the owner's assessment of the horse (e.g. Mair *et al.* 1992, Madigan *et al.* 1995, Madigan and Bell 2001). This was supported by Mair *et al.* (1992) on the basis that their observation of the symptoms led to the horse to be presented to the surgeon for subsequent diagnosis and the likelihood that the headshaking may be altered at the clinic for other reasons. However, current reports of treatment have relied on owner assessment of 'slight', 'partial' and 'considerable' improvement, but these can have different meanings depending on the owner's personal interpretation. This study has aimed to not only demonstrate the consistency and hence reliability of reports from owners but to provide a methodology for a more objective measure of the severity and occurrence of the various headshaking signs (see Chapter

9). This will allow reports of the change in headshaking signs to be compared more accurately between treatments, something that can only help increase our understanding.

14.5 The placebo effect

There are four general reasons that account for observed improvement in a patient's condition during treatment. These are natural resolution, regression to the mean and the non-specific and specific effects of the treatment in question (Bienenfeld *et al.* 1996). These reasons apply to trials of treatments for animals just as they do for humans. In clinical trials placebos are used to establish the specific effects of a treatment, i.e. they 'control' for all other reasons that might have accounted for any improvement. A placebo is any "intervention that has a non-specific, psychological or psychophysiologic therapeutic effect...but is without specific activity for the condition being treated" (McMillan 1999). The trial of the magnatherapy headcollar (Chapter 12) and the herbal supplement (Chapter 13) were both controlled by placebos. Each horse received a placebo treatment and a verum treatment and the owner and the researcher remain blind to the identity of each until after the trial. In the trial of the herbal supplement, a significant improvement in headshaking was reported under both the verum and the placebo (see Table 14.1). In the trial of the magnatherapy headcollar, a significant improvement was reported during application of the placebo headcollar only (see Table 14.1). In both trials, however, there was no evidence of a difference in improvement between verum or placebo treatment. As a result, it can be concluded that there was no evidence of any significant specific effect of the treatments. However, had the trial not been placebo controlled, these results might have been regarded as evidence of the efficacy of the treatment (in some cases with the placebo). What follows is a discussion of how natural resolution, regression to the mean and the non-specific effects of the trial may have resulted in a significant improvement under placebo treatment[1].

[1] Just as it is possible that a treatment might have a detrimental specific effect, deterioration in the patient can also be explained by these three effects. However, to avoid duplication of arguments, only improvement will be considered.

14.5.1 Natural resolution

Natural resolution is the chance that some patients will improve over the course of the trial due to the natural progression of the disease (Linde 2000). In the case of headshaking, improvement due to 'natural resolution' could be particularly influential due to the intermittency of the condition and reports of spontaneous improvement. Spontaneous improvement has been reported to occur when the horse is moved to a different area for example (Lane and Mair 1987) and can cause difficulties in evaluating treatments when the horse is sent to the clinic for treatment, for example (Mair *et al.* 1992, Newton *et al.* 2000). A comparison between a single observation and a report of the severity of the horse's usual problem in Chapter 8 suggested that the headshaking condition can be particularly intermittent from day to day. Whilst this might not reflect genuine, lasting improvement in the horse, it may appear initially as such to the owner, particularly if the horse continues to 'improve' throughout the trial. This phenomenon could account for the observation in the bitless bridle trial (Chapter 10) that the only two horses that had been reported to completely cease headshaking during the trial were reported to regress a few days following the trial whilst continuing to use the bridle.

Both the short and long-term intermittency of the headshaking is often (rightly or wrongly) attributed to improvement in the presence or absence of certain environmental triggers factors (see Chapter 3). It is therefore possible that it might also be attributed to a concurrent treatment. Nearly 40% of horses were reported to have improved from the previous year and this was variously attributed to alternative therapies or changes in weather conditions (see Section 3.4.7.5). The influence of short-term intermittency can be avoided to some extent by increasing the length of the trial and using owners to observe the horse throughout the period of treatment (see above). However, there is the danger that long-term trials may be affected by natural resolution of the problem towards the end of the summer. Since, nearly 90% of the horses in the survey described in Chapter 3 had some seasonal exacerbation to their problem, this might explain the anecdotal success of mid-to-long term therapies. The absence of any specific effect of the herbal treatment over 5-weeks in the trial in Chapter 13 raises the suggestion that the apparent popularity of this and other similar treatments may be more to do with natural cessation of headshaking towards the winter rather than any specific effect of the treatment. And, since improvement was reported in nearly 40% of horses compared to the previous year (see above) this might explain the apparent curative effect of the treatment. Natural resolution and the intermittency of the headshaking condition provide a mechanism by which non-conventional treatments are remaining popular with owners despite the lack of scientific evidence of their specific effect. Mair *et al* (1992) only concluded that that intra-orbital neurectomy had been effective in those cases where improvement lasted more than 12 months.

14.5.2 Regression to the mean

Improvement can also be as a consequence of 'regression to the mean', which is the extent of variation in the measurement of the patient's condition (McMillan 1999). Variation may be a reflection of the methods used to measure the improvement in the patient but also the natural variation of the condition between periods of measurement. In these trials the owners rated the frequency of headshaking signs on a scale. Although this may have been a less objective method of assessment, than, for example, counts of headshakes, it probably reduced the extent by which the assessment could vary by providing a more limited range (scale). Similarly, asking owners to 'average' the occurrence and severity of their horse's condition over the course of the week reduced the amount of variation in the data that would have occurred if several reports had been made and averaged mathematically. This is particularly pertinent given the intermittency of the headshaking problem (see above).

The chances of regression to the mean causing significant, overall reported improvement decrease as the sample size increases, since it becomes more likely that improvement and deterioration between the patients will cancel each other out (Bienenfeld *et al.* 1996). However, the samples sizes of the trials in this study were relatively small. This, together with the small reported effect size of the bitless bridle, face mask and magnetic headcollar relative to the extent of the variation suggests that regression to the mean might explain the observed improvement. As a reflection of this, the power of these trials to detect a significant difference between treatment and baseline assessment was very small. Consequently, for these interventions the size of the effect is likely to be small and a significant treatment-baseline difference might be found only in a trial of several hundred horses. This suggests that significance of these treatments in a clinical (i.e. practical) sense is small. The estimation of the likely effect size is one of the purposes of a safety and efficacy trial, and in this regard the uncontrolled trials of the bridle and the face mask, have served this purpose well. A large influence of regression to the mean caused by the small sample size may explain the statistically significant improvement when the horses were wearing the placebo headcollar. Had this effect been observed with the verum headcollar and not compared relative to placebo this might have been regarded of evidence of efficacy.

14.5.3 Non-specific effects

Non-specific effects of a treatment that are not a consequence of any specific action on the animal's physiology, and are not attributed to regression about the mean or natural resolution, are usually called placebo effects (McMillan 1999). The extent to, and manner by, which treatments might have a non-specific effect can vary. There is increasing evidence that the reported efficacy of alternative and complementary therapies may be due in part to particularly large non-specific effects (Walach 2001). For example, in a placebo-controlled trial, Abbot *et al.* (2001) found no significant difference between spiritual healers and sham healers (actors) in their ability to reduce chronic pain as measured by validated pain assessment scales. However, the extent to which both sham and spiritual healing were reported to reduce the pain was very large, an effect size in the order of 0.8. As a result, one could argue that both treatments were extremely effective. However, in the strict, scientific sense, spiritual healing would not have been considered to be effective in this context because the effect cannot be attributed to anything specific to spiritual healing (i.e. the improvement was also reported with sham healing). A similar situation appears to have arisen in the placebo-controlled trials of the magnetic headcollar and the herbal supplement described here. Non-specific effects of the trial on the reports of the owner, on the horse's condition and as a consequence of the placebo control itself may have also contributed significantly to the reported improvement.

14.5.3.1 Non-specific effects on the reports of the owner

Simply being part of a trial may have affected the owner's ability report objectively regarding the severity of their horse's symptoms. For example, their enthusiasm for the trial and the hope that the applied intervention would help their horse may have affected their perception of the horse's problem. The owner may also feel more optimistic due to the trial process; being in contact with someone who is studying the problem and feeling that they are closer to understanding the causes of the problem. The latter is reported to be a particularly important therapeutic factor for human patients (Frank 1989). Since owners are assessing their horse, it is feasible that their reports are just as affected by these non-specific effects as they would be if the owner themselves were the patient. To reduce this effect, the measures of primary importance asked for a semi-objective assessment of the horse's headshaking before and during the intervention, as opposed to a simple judgement of whether the horse had improved or not (see Chapter 9). In addition, asking the owners to return the baseline assessment as soon as it had been made reduced the possibility that they had a reference to compare to and hence forced them to assess their horse more independently. In the herbal supplement trial the owners retained the baseline assessment, which may in part explain the higher percentage improvement in this trial compared to the other trials (see Table 14.1). Owners may not always tend to report improvement however; some may be disappointed with the intervention because it has not totally cured their horse and be more pessimistic with their scoring as a result. These tendencies may balance out, rendering owners just as objective as any other method. For example, in a placebo-controlled trial of a drug treatment for canine osteoarthritis, 56% of dogs improved in the objective measurement of lameness compared to 38% in the dog owner's subjective assessment (Vasseur *et al.* 1995). Nonetheless, Hrobjsartsson and Gotzsche (2001) reported a small, but significant placebo effect in a meta-analysis of trials in which pain was being measured and the outcome was measured on a continuous subjective scale. Both situations probably apply to the trials discussed here.

The type of intervention under study may also influence the extent to which the owner tends to report improvement. This might explain the larger effect of the headcollars and the herbal supplement over the management devices (the mask and bridle), see Table 14.1. Given their 'ugliness' (particularly the mask) and inconvenience (e.g. having to ride in an unfamiliar bridle that they cannot compete in) owners may be more critical of these interventions. In contrast, the headcollar and supplement were not ugly, but did require constant application of the treatment, either in the horse wearing the headcollar or being fed the supplement. This may have increased the seriousness of the trial and the owner's emotional input as a result. In addition, putting something *inside* the horse's body, as opposed to *on* the horse may further increase the expectancy of improvement. This may explain the greater reported improvement with the herbal supplement over magnetic headcollar, see Table 14.1. Finally, the time frame in which the intervention is expected to produce improvement may alter the owner's perception of its efficacy. With a device such as a bridle or face mask, it should be quickly apparent to the owner whether the horse has improved or not. They may therefore be more objective with these interventions. The absence of any significant effect of the face mask would support this. However, with both the magnetic headcollar and the herbal supplement some delay was expected before any effect would be apparent. Vagueness as to when the effect would be seen might have increased the optimistic owner's tendency to be more favourable towards the intervention. It might encourage them to look harder for improvements since they are expecting them to be more subtle, at least initially. Indeed, perhaps it is the 'air of mystery', which often surrounds the mechanism and expected efficacy of alternative and complementary therapies that explains the large non-specific effect in any report.

14.5.3.2 Non-specific effects on the horse's condition

Participation in the trial might have altered the way in which the owner managed and rode their horse. This might have a direct or indirect effect on the horse and hence the headshaking. If, for example, the trial made the owner ride in a more positive and/or benign manner then this might have directly influenced the horse for the better. If the owner felt more positive or relaxed because they were doing something to help their horse this may be picked up by the horse. Because animals can perceive and respond to emotional states of humans, there may be a conveyance of optimism to the horse, which might contribute to a somatic response (McMillan 1999). Since it has been reported that the headshaking can be negatively influenced by the horse being reported to be nervous or excited (see Chapter 3) then both direct and indirect explanations for an improvement in the headshaking as a result of the trial are possible.

Part of the non-specific effects of the trial may have arisen from a conditioned response in the horse. In classical conditioning theory, if an initially neutral stimulus is presented repeatedly with an unconditioned stimulus that elicits a known specific response, the association of the unconditioned stimulus with the neutral stimulus eventually results in the animal responding in the same or similar manner to the neutral response alone (Bienenfeld *et al.* 1996). When treating an animal for a disease, the animal may become conditioned to the therapeutic milieu surrounding successful treatment in the past and this may invoke some kind of response in the absence of any specific effect of a new but similar treatment (Voudouris *et al.* 1985). This might be more likely to occur if the animal is treated at the veterinary clinic where there are plenty of other stimuli that accompany treatment. It has been suggested that this might explain why some patients cease vomiting immediately upon entry to the veterinary clinic (McMillan 1999). Therefore conditioning might in part also explain the reported spontaneous improvement in headshakers when taken to the clinic for treatment (for example in Newton *et al.* 2000) and provides another argument for evaluation of the horse in its home environment where there are likely to be fewer conditioned stimuli.

It may not be likely that a conditioned response to wearing a headcollar or receiving a supplement had occurred in the horses prior to the trial, since if these had produced improvement in the horse, at least for headshaking, they would not be participating in another trial. However, the nature with which the supplement was fed to the horse, as a treat separate to its normal food ration, does raise the possibility that some conditioned or learnt response might have occurred in this situation. One suggestion for this is if the owner used the biscuits to catch the horse for riding and as a result the horse learnt that being caught and being ridden involved being given treats (a good thing). This process may have made the riding experience more pleasant for the horse, lowering its stress levels and the headshaking as a result. There is also the possibility that the owner unconsciously rewarded the horse for not headshaking with the treats. This phenomenon is worthy of further investigation.

14.5.3.3 Non-specific effects as a consequence of the placebo-control

All the non-specific effects described above apply equally to the placebo and the verum if all those directly involved in the trial remain blind to their identity. So, although there is the possibility that they have produced a significant reported improvement in the horse, they have been effectively controlled for by placebo. This is why blinding is so important. However, the larger improvement reported in the two placebo-controlled trials compared to the field trials of the facemask and bridle may not be explained solely by differences in the type of intervention. The greater reported improvement in the placebo-controlled trials may have been an effect of the use of the placebo itself.

As a consequence of participating in a placebo-controlled trial, the owner may have tended to report improvement rather than deterioration because they knew that they were getting the real thing at some point. Rather than being 'caught out' at the end of the trial when the identity of the treatments would be revealed to them, they might have consciously or unconsciously 'hedged their bets' and reported improvement in both treatment periods. Not using a placebo may therefore actually encourage the owners to be more objective. They may feel more comfortable about being negative about the treatment when they know what they have used and when. This may have been the case in the trial of the facemask where improvement in some cases was no more or less likely to have been reported and an overall significant improvement in the primary measures was not found. Use of placebo may also raise the 'seriousness' of the trial in the eyes of the participants, increasing their emotional input into the trial and its outcome as a result.

There is also the possibility that the cross-over trials introduced an 'order effect' and as a consequence one can have less confidence in results of the second treatment period (Jones and Kenward 1989). This can occur by insufficient washout of the first treatment, making the second treatment look less effective due to an already improved baseline assessment. Increased optimism on the part of the owner at the start of the trial may result in improvement being more likely to be reported for the first treatment. On the other hand, the second treatment may appear equally or more successful to the first if the horse has become conditioned to improve when treated as a consequence of feeling better when receiving the first treatment (see above). However, this assumes some specific effect of the verum was present, but an (un-presented) evaluation of the outcomes from the first period of the supplement trial found no evidence to suggest this. These order effects can be ignored if cross-over trials are balanced (equal numbers and type of horse receive verum and placebo in the first period). However, in the magnetic headcollar trial, more horses tested the placebo first, which may explain its apparent, although not significantly greater efficacy over the magnetic.

14.6 Implications and recommendations for future work

Natural resolution (including spontaneous remission), regression to the mean and non-specific effects (the placebo effect) can explain the significant improvements reported in the horses under placebo treatment in the controlled trials. The fact that greater improvement was reported in the placebo-controlled trials, compared to the field trials, suggests that some of the improvement was due to the non-specific effects of the use of alternative-type treatments whose immediate efficacy was not expected and/or the use of a placebo itself. As a consequence of these findings the following recommendations for future trials of treatments for headshaking are made:

1. An initial field study of an appropriate number of horses (20-30) is conducted in order to estimate the effect size and the number of horses required to conduct a more controlled study with sufficient power to detect a significant effect of treatment. However, if the estimated size of the effect is small then the treatment in question

may be of limited clinical use. Observational studies such as those conducted on the management devices provide a useful basis for future studies but do not provide reliable evidence of efficacy (Linde 2000). It is surprising then that these have formed the basis of our knowledge of treatment for headshaking to date.

2. Horses are observed in their home environment under the care and observation of the owner. This will reduce the likelihood of spontaneous improvement occurring in a novel environment and will ensure the treatment is tested in the situation in which it will be used. Several observations of the horse need to be made to account for the day-to-day and location-to-location variability of the headshaking within each horse. Care should also be taken to ensure the length of the trial is not affected by the seasonal variability of the headshaking.

3. Objective or semi-objective measures are used to assess the horse before and after treatment (for example, the scales shown in the assessment form in Appendix IX). When evaluating more than one treatment, comparing the change relative to baseline between treatments may be a better measure than direct comparison of the treatment scores, because the variability of the headshaking may increase the chance that a single measure is unreliable. Removing the baseline assessment from the owner may make them more objective in their assessment of the treatment.

4. Control for natural resolution, regression to the mean and non-specific effects with placebo. Although there was a suggestion that use of placebo may encourage reports of improvement this is still controlled for by the placebo. Inherent in the use of placebo is blinding to the treatment types, and comparison of the change in the horse relative to that occurring under placebo as the final outcome measure of interest. Evidence of improvement, as occurred in the trials here, should not be treated as evidence of specific efficacy of the treatment unless it is significantly higher than the placebo.

5. For some treatments, the use of placebo may not be possible (e.g. the bitless bridle). Some non-specific effects could have been controlled for by also evaluating the

change in headshaking with another type of bitted bridle, but the owners and horse would not be blind to these and this other bridle may have had specific effects of its own. In the absence of placebo-control or comparison with another treatment whose effect is known, a minimum success rate (or effect size) should be achieved in order to cover for all improvements that may not be due to any specific efficacy on the part of the treatment. Using the largest improvement observed with placebo in the herbal supplement trial (see Table 14.1) it is reasonable to suggest that reported improvement in over 70% of subjects and substantial improvement (by at least 50%) in 30% can be caused by the effect of participation. Studies with reported improvement lower than this may therefore only make conservative conclusions. As a result, the improvement reported with the bitless bridle was under this threshold, whilst the nose net trial exceeded it (see Table 14.1). Additional studies may be required to establish whether this is a fair estimate (see below), since some of this improvement may have been caused by the placebo-control itself. Difficulties with this method are that treatments with medium-sized specific effects may be discarded by this rule, for example the bitless bridle. Also, given that headshaking is likely to have multiple aetiologies, obtaining a significant level of improvement with a treatment that has a specific mode of action will be difficult. In both instances, placebo-controlled cross-over trials where each horse acts as its own control are a better method, even though increasing the number of horses in the trial may also help.

In order to test some of the suggestions made above and in order to advance our understanding of headshaking given the research described herein, a number of further studies are proposed:

1. An evaluation of the relative influence of natural progression, regression to the mean and non-specific effects on the reported improvement in headshaking following treatment. A no-treatment period within the same trial may establish how much change can be attributed to natural resolution and regression to the mean compared to the non-specific effects of treatment, for example as in Abbot *et al.* (2001). Similarly, an uncontrolled trial of the placebo treatment running alongside a

placebo-controlled trial might be able to distinguish between those non-specific effects caused by the application and assessment of the treatment and those that are a consequence of the trial being placebo controlled.

2. A comparison of objective assessment of change in the horse compared to semi-objective assessment by the owner, for example as in Vasseur *et al.* (1995). Objective assessment may include some measure of the number and size of the headshakes using some kind of device that measures vibration (like a pedometer attached to the horse's bridle)

3. Design and evaluation of the efficacy of a practical occlusive mask and identification of prognostic factors that might predict response to this.

4. An investigation of the role of conditioning in trials of treatments for headshaking

5. A comparison of objective assessments and owner reports of the variation of headshaking with prevailing weather conditions to assess whether the influence of trigger factors is genuine

14.7 Summary

This work has utilised several different scientific techniques in an effort to increase the knowledge of the presentation, proximate and ultimate causes of and treatments for the headshaking condition. Similarity in presentation of the condition between veterinary case reports and self-selected surveys both in the UK and USA supports the assertion that headshaking and its associated signs is a final common pathway for the expression of irritation in the horse, which may have arisen from several different origins. This is supported by the finding that the reported presence of a range of signs related to naso-facial irritation, within a survey sample of headshakers, did not appear to increase the ability to differentiate between these causes. However, this technique is currently limited by lack of successful treatments with a known, specific mode of action.

As veterinary medicine moves more towards an evidence-based outlook, an evaluation of the methods used to assess the effectiveness of a treatment remains relevant. A methodology for the design of trials of management aids in the field was described. This was based on application of principles from clinical trial design and a demonstration of the consistency of the reports from horse owners. Results from two placebo-controlled trials of alternative-type interventions included significant improvements reported in the horses under placebo. Spontaneous regression, variability of the headshaking and the expectation that surrounds treatments that require constant application to the horse (particularly internally) for period of time before an effect is expected were suggested as the main reasons for this improvement. These may therefore provide an explanation for the apparent popularity of alternative and complementary treatments for headshaking which have evaded proper scientific evaluation until now. It has long been recognised that randomised, controlled trials (or a meta-analysis of these) provide the most reliable evidence of the specific efficacy of treatments (Mair 2001). Given that these have also not been reported for conventional treatments for headshaking, the specific efficacy of these treatments must also remain in doubt.

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Appendix I Case-control survey

NEHS Ref. No. This Questionnaire is Strictly Confidential

NATIONAL EQUINE HEADSHAKING SURVEY (NEHS): CASE CONTROL QUESTIONNAIRE

THIS QUESTIONNAIRE IS TO BE COMPLETED FOR A HORSE **OTHER THAN THE HEADSHAKER**, WHO IS KEPT AT THE SAME YARD OR NEARBY PREMISES AND WHOSE DETAILS CLOSELY RESEMBLE THOSE OF THE HEADSHAKER.

OWNER DETAILS

Name:

Address:

Telephone:

Would you be willing to be contacted again at a later date regarding this work? Yes/No

Would you be interested in receiving a report summary? Yes/No

HORSE DETAILS

Name of Horse:

Age of Horse:________Years______Months

Height of Horse:______Hands______Inches

Sex of Horse: Mare [ ] Gelding [ ] Stallion [ ]

Breed of Horse:

Horse's colour & markings:

What is the horse used for?

HISTORY

1. Does the horse suffer from COPD (Chronic Obstructive Pulmonary Disease)? Yes [ ] No [ ]
2. Does the horse suffer from any other respiratory problem? Yes [ ] No [ ]
3. Does the horse have any known allergies? Yes [ ] No [ ]

BEHAVIOURAL CHARACTERISTICS

Does your horse exhibit any of the following? (Please tick all applicable answers)

4. Does the horse shake its head at rest?	Yes	[ ]	No	[ ]
5. Does the horse shake its head at exercise?	Yes	[ ]	No	[ ]
6. Does the horse shake its head when excited?	Yes	[ ]	No	[ ]
7. Does the horse shake its head from side to side?	Yes	[ ]	No	[ ]
8. Does the horse shake its head up and down?	Yes	[ ]	No	[ ]
9. Does the horse appear to 'flip' its nose?	Yes	[ ]	No	[ ]
10. Does the horse act like an insect is up its nose?	Yes	[ ]	No	[ ]
11. Does the horse display excessive snorting or sneezing?	Yes	[ ]	No	[ ]
12. Does the horse rub its nose on the ground whilst stationary?	Yes	[ ]	No	[ ]
13. Does the horse rub its nose on the ground whilst moving?	Yes	[ ]	No	[ ]
14. Does the horse rub its nose on objects?	Yes	[ ]	No	[ ]
15. Does the horse strike at its face with a foreleg?	Yes	[ ]	No	[ ]

MANAGEMENT

16. Which of the following applies to your horse? (please tick all applicable answers and comment if necessary)

a). Lives out in summer & stables in winter [ ]

b). Stabled at night & turned out in the day [ ]

c). Turned out at night & stables during the day [ ]

d). Stabled all the time [ ]

e). Lives out all the time [ ]

17. What best describes where the horse is kept? (Please tick all applicable answers)

a). Rural area [ ]

b). Developed urban area [ ]

c). Developed industrial area [ ]

d). Surrounded by grazing pasture [ ]

e). Surrounded by arable crops [ ]

f). Surrounded by woods/forest [ ]

18. How many other horse are kept at the same place?___________

19. Are there any headshakers at the same place? Yes [ ] No [ ]

If yes, please give details if possible and a separate questionnaire will be sent if required

____

____

____

20. How often is the horse wormed?

Monthly [ ] Every 5-8 weeks [ ] Every 9-12 weeks [ ] Less than every 12 weeks [ ]

21. How often is the horse's teeth checked?

Twice yearly [ ] Yearly [ ] Every 1-2 years [ ] Less then this [ ]

22. Is the horse clipped at any time? Yes [ ] No [ ]

(If yes, please state when)____

23. Have the horse's whiskers been removed? Yes [ ] No [ ]

24. What bedding is used for this horse?

(If more than one type is used please tick all applicable but specify which is used most often)

a). Straw	[ ]	b). Treated chopped straw	[ ]
c). Untreated chopped straw	[ ]	d). Woodshavings	[ ]
e). Sawdust	[ ]	f). Paper	[ ]
g). Auboise	[ ]	h). Other	[ ]

25. What does the horse's diet consist of? (Please tick all applicable answers)

a). Grass	[ ]	b). Hay	[ ]
c). Haylage	[ ]	d). Hi Fi/Chopped alfalfa mix	[ ]
e). Sugar beet	[ ]	f). 'Straights'	[ ]
g). Nuts/cubes	[ ]	h). Ready mix concentrates	[ ]
i). Herbal supplement	[ ]	j). Vitamin/mineral supplement	[ ]
k). Probiotic (e.g. Blue chip)	[ ]	l). Other (please specify)	[ ]

26. Where does the horse's drinking water come from?

Mains tap [ ] Bore hole [ ] Well [ ] Other [ ]

27. Which best describes the horse's workload?

Worked every day	[ ]	3-5 days per week	[ ]
1-2 days per week	[ ]	Less then once a week	[ ]

TREATMENT

28. Who is your usual vet? (Please provide their name, practice name and address)

____

____

29. Is the horse vaccinated against flu and tetanus? Yes [ ] No [ ]

If yes, when is the next vaccination due?______________________________

30. Has the horse ever been treated by a vet for any condition? Yes [ ] No [ ]

If yes, please give details

____

31. Has the horse ever been treated by a 'back specialist' for any condition? Yes [ ] No [ ]

If yes, please give details

____

32. Has the horse ever been treated by homeopathy for any condition? Yes [ ] No [ ]

If yes, please give details

____

33. Has the horse ever been treated by any other alternative therapy for any condition?

If yes, please give details Yes [ ] No [ ]

____

34. If you feel there are any other factors relating to the horse which are not covered in this questionnaire please use the reverse of the questionnaire to comment.

THANK YOU VERY MUCH FOR YOUR GENEROUS ASSISTANCE

Appendix II Modifications to the survey by Mills *et al.* (2002a) (Q1998) included in the present survey (Q2000)

Q1998	Q2000
Association with events prior to onset	
– Was the onset of the condition associated with any condition or behavioural problem? (Y/N, specify)	– Upon purchase did you move the horse to a different area? (Y/N) – Has your horse's kind and level of work changed significantly since you bought it? (Y/N, specify) – Can you remember anything that occurred prior to the onset of the headshaking? (Y/N, specify)
Seasonality	
– Do you consider the horse to be a seasonal headshaker? (Y/N, specify) – What time of year does the headshaking start/cease? (specify)	– In which month did your horse first start headshaking? – When did your horse start headshaking this year? – Shade in the box for each month of the year that corresponds to the severity (0-4) and occurrence (0-4) of headshaking when ridden
Change in severity and occurrence from year to year	
– Does the season remain the same, get longer or get shorter every year? – Does the intensity remain the same, increase or decrease every year?	– If you horse headshakes all year round, was there ever a seasonal pattern to it? – How does the headshaking compare to last year? (same, better, worse, don't know) – Since your horse first began headshaking has it improved, stayed the same or worsened with respect to severity, and occurrence?

Q1998	Q2000
Signs associated with the headshaking	
Does the horse: Shake its head from side to side, shake its head up and down, appear to 'flip' its nose, act like a bee is up its nose, snort/sneeze with the headshaking, rub its nose on the ground whilst stationary, rub its nose on the ground whilst moving, rub its nose on objects, strike at its face with a foreleg? (y/n to each)	Place tick in each box for the occurrence of each sign 'when stabled', 'when grazing', 'when ridden' and 'after being ridden': Vertical headshaking, horizontal headshaking, twisting/rotary headshaking, odd head carriage, flipping of the top lip/ nose, snorting, sneezing, rubbing the nose on objects, rubbing the nose on the foreleg, dropping the nose to the ground, striking of foreleg onto nose, striking out of foreleg, clamping the nostrils, coughing, odd/heavy breathing, signs of inflammation (where?), sweating (where?), nasal discharge (clear, yellow or white?), twitching (where?), watering eyes, blinking, heavy eyelids/dopey expression, staring into space, stumbling/in-coordination, rushing forward/panicking, unwillingness to move/stopping, other (specify)

Cont.

Q1998	Q2000
Influence of certain conditions on the headshaking	
– Does the horse shake more, less or the same *when excited, on bright sunny days, on rainy days, on windy days, at night, indoors*?	– How is the headshaking affected when your horse is,: *feeling nervous, feeling excited, encouraged to concentrate*, as *exercise progresses*, ridden on *bright, sunny days*, on *overcast days*, on *windy days*, at *night-time, indoors*, in *traffic*, through *clouds of midges/flies, warm days, in the rain*, through *wooded areas*, through *arable areas, in open spaces, near loud or sharp sounds* (improves, worsens, not affected, don't know)
Reported response to conventional and non-conventional treatment	
– Has the horse ever been treated by a vet, a back specialist, homeopathy or any other alternative therapy for the headshaking? (if yes, please specify and give level of effect) – Did you find any of the following useful to control the headshaking? (complete success, partial success, no success, not tried) – nose veil, ear net, face net, feed supplement.	– What treatments have you tried for headshaking?–Veterinary advice, veterinary treatments, a back specialist, herbal supplements, homeopathy, nose net, face net, bitless bridle, other. (tried, not tried) – For each was there any improvement? (none, partial, substantial, complete)

Appendix III Q2000 Survey

NEHS Ref. No. This Questionnaire is Strictly Confidential

NATIONAL EQUINE HEADSHAKING SURVEY (NEHS)

Research Supervisor: Daniel Mills, BVSc MRCVS
Researcher: Katy Taylor, BSc

OWNER DETAILS

Name:
Address:

Telephone:
Email:

Would you be willing to be contacted again at a later date regarding this work?

Yes [ ] No [ ]

Would you be interested in receiving a report summary?

Yes [ ] No [ ]

HORSE DETAILS

Name of Horse:______________________________

Age of Horse______Years_____Months Or approx. DOB (mm/yy) ____________

Height of Horse: ______Hands______Inches

Sex of Horse: Mare [ ] Gelding [ ] Stallion [ ]

Breed of Horse:______________________________

Horse's colour & markings:______________________________

What is the horse used for?

[ ] Primarily pleasure
[ ] Riding school
[ ] Some local competitions
[ ] Some affiliated competitions
[ ] Professional Competition
[ ] Other______________________

HISTORY (Please note these answers will remain totally confidential)

1. How long have you owned the horse? _______Years______Months

2. Did you know it was a headshaker when you acquired it? Yes [ ] No [ ]

3. In what month did you acquire it? ______________________

4. Upon purchase, did you have to move the horse to a different area? Yes [ ] No [ ]

5. Has your horse's kind of work changed significantly since you bought it?

Yes [ ] No [ ] Don't know [ ]

If Yes, please specify____

6. Has your horse's level of work changed significantly since you bought it?

Yes [ ] No [ ] Don't know [ ]

If Yes, please specify____

7. How long has the horse been known to be a headshaker? ______Years______Months

8. In which month did your horse first start headshaking? ________________________

9. How old was the horse at the onset of the headshaking? ______Years______Months

10. Can you remember anything that occurred prior to the onset of the headshaking? e.g. an illness/moving areas/change in type or level of work?

Yes [ ] No [ ]

If Yes, please give details of the event and its timing

____

____

11. Does headshaking prevent you from fully utilising your horse?

Yes [ ] No [ ] If No, why not? ___________________________

If yes, in what way ? (tick all those that apply)

[ ] Cannot ride at all during headshaking period
[ ] Must ride for shorter periods
[ ] Cannot ride in certain areas/situations
(please specify)____________________________________
[ ] Cannot do certain activities, e.g. jump/dressage
(please specify)____________________________________
[ ] Other
(please specify)____________________________________

12. At its worst, my horse's headshaking is:

[ ] Barely noticeable
[ ] Annoying but bearable
[ ] Unpleasant & difficult to control
[ ] Dangerous and the horse is unrideable

13. Is your horse insured? Yes [ ] No [ ]

14. Have you ever made a loss of use claim because of the headshaking?
Yes [ ] No [ ]

What was the outcome of this?

____

15. When did your horse start headshaking this year? (dd/mm) ______________

16. If your horse headshakes all year round, was there ever a seasonal pattern to it?

Yes [ ] No [ ] Don't know [ ]

17. How does the headshaking compare to last year?

Worse [ ] Same [ ] Better [ ] Don't know [ ]

If different, in what way & why do you think this is?

____

____

18. Since your horse first began headshaking, has it-

with respect to **severity**:
Improved [ ] Stayed the same [ ] Worsened [ ] Don't know [ ]

with respect to **occurrence:**
Improved [ ] Stayed the same [ ] Worsened [ ] Don't know [ ]

19. For each season, please mark **how often** you ride your horse:

	Spring	Summer	Autumn	Winter
Every day				
5-6 days a week				
3-4 days a week				
1-2 days a week				
Less than once a week				

20. For each season, please mark on average **how long** you ride your horse for each session:

	Spring	Summer	Autumn	Winter
Less than an hour				
1-2 hours				
2-3 hours				
More than 3 hours				

21. Has your horse ever had any dental attention, e.g. rasping, extraction, etc?

Yes [ ] No [ ]

If so, what was done and when?

____

22. As far as you are aware, has your horse ever damaged its face or muzzle?

Yes [ ] No [ ]

What happened and when did this occur?

____

____

23. What is it like to bridle your horse?

Very difficult [ ] Difficult [ ] Hard to say [ ] Easy [ ] Very easy [ ]

24. Is your horse vaccinated against flu? Yes [ ] No [ ]

If Yes, please look at your horse's vaccination card and write down:

When the last vaccination was ______________________________

The name of the last vaccine ______________________________

The names of other vaccines used (& dates), if different from above

____

25. Is your horse vaccinated against tetanus? Yes [ ] No [ ]

If Yes, please look at your horse's vaccination card and write down:

When the last vaccination was ______________________________

The name of the last vaccine ______________________________

The names of other vaccines used (& dates), if different from above

____

26. BEHAVIOURAL CHARACTERISTICS

Please read through this list carefully and for each of the occasions mentioned please mark which signs your horse has shown. (An absence of a mark means the horse has not shown this sign)

Symptoms	When stabled	When grazing	When ridden	After being ridden
Vertical headshaking				
Horizontal Headshaking				
Twisting/rotary headshaking				
Odd head carriage				
Flipping of top lip/nose				
Snorting				
Sneezing				
Acting like a bee flew up nose				
Rubbing nose on objects				
Rubbing nose on foreleg				
Dropping nose to the ground				
Striking of foreleg onto nose				
Striking out of foreleg				
Clamping (shutting) the nostrils				
Coughing				
Odd/heavy breathing				
Signs of inflammation Where?.....................				
Sweating? Where?.....................				
Nasal discharge Clear Yellow or White?				
Twitching? Where?....................				
Watering eyes				
Blinking				
Heavy eyelids/dopey expression				
Staring in space				
Stumbling/In-coordination				
Rushing forward/panicking				
Unwillingness to move/ stopping				
Other................................				

27. During the headshaking season does your horse ever attempt to hide its entire head/muzzle from the sunlight? (delete as appropriate)

Yes [ ] No [ ] Don't know [ ]

If Yes, How does it attempt to do this?

---

28. Is your horse sensitive in the muzzle/poll/facial areas? (delete as appropriate) i.e. Does it dislike being touched there by you, the bridle or small falling objects, etc?

Yes [ ] No [ ] Don't know [ ]

(please specify)

---

29. How is the headshaking affected when your horse is feeling nervous?

Improves [ ] Worsens [ ] Not affected [ ] Don't know [ ]

30. How is the headshaking affected when your horse is feeling excited?

Improves [ ] Worsens [ ] Not affected [ ] Don't know [ ]

31. How is the headshaking affected when your horse is encouraged to concentrate?

Improves [ ] Worsens [ ] Not affected [ ] Don't know [ ]

32. How is the headshaking affected as exercise progresses?

Improves [ ] Worsens [ ] Not affected [ ] Don't know [ ]

33. How is the headshaking affected by riding on bright, sunny days?

Improves [ ] Worsens [ ] Not affected [ ] Don't know [ ]

34. How is the headshaking affected by riding on overcast days?

Improves [ ] Worsens [ ] Not affected [ ] Don't know [ ]

35. How is the headshaking affected by riding on windy days?

Improves [ ] Worsens [ ] Not affected [ ] Don't know [ ]

36. How is the headshaking affected by riding at night-time?

Improves [ ]   Worsens [ ]   Not affected [ ]   Don't know [ ]
(can you try?)

37. How is the headshaking affected by riding indoors?

Improves [ ]   Worsens [ ]   Not affected [ ]   Don't know [ ]
(can you try?)

38. Is the headshaking affected by riding in traffic?

Improves [ ]   Worsens [ ]   Not affected [ ]   Don't know [ ]

39. How is the headshaking affected by riding through clouds of midges/flies?
(delete as appropriate)

Improves [ ]   Worsens [ ]   Not affected [ ]   Don't know [ ]

40. How is the headshaking affected by riding on warm days?

Improves [ ]   Worsens [ ]   Not affected [ ]   Don't know [ ]

41. How is the headshaking affected by riding in the rain?

Improves [ ]   Worsens [ ]   Not affected [ ]   Don't know [ ]

42. How is the headshaking affected by riding through wooded areas?

Improves [ ]   Worsens [ ]   Not affected [ ]   Don't know [ ]

43. How is the headshaking affected by riding through arable areas?

Improves [ ]   Worsens [ ]   Not affected [ ]   Don't know [ ]

Any crops in particular?

---

44. Is the headshaking affected by riding in open spaces, e.g. moor land or beaches?

Improves [ ]   Worsens [ ]   Not affected [ ]   Don't know [ ]

45. Is the headshaking affected by riding near loud or sharp sounds?

Improves [ ]   Worsens [ ]   Not affected [ ]   Don't know [ ]

46. Does anything else affect your horse's headshaking?

For the better ____

For the worse ____

47. Please shade in the box for each month of the year that corresponds to the occurrence of headshaking in your horse when ridden:

Every time												
*Often												
*Occasionally												
Never												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

If *, please specify under what particular situations the headshaking occurs, if you can

____

____

48. Please shade in the box for each month of the year that corresponds to the severity of the headshaking in your horse within any given bout:

Dangerous												
Unpleasant												
Bearable												
Barely noticeable												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

49. Is the headshaking any different when the horse is lunged?

Much worse [ ] Worse [ ] Same [ ] Better [ ] Much better [ ] Don't know [ ]

In order that we may estimate the proportion of male and female horses in the UK population, please have a quick look around the yard or field where your horse is kept and write down:

50. How many horses are in the same yard/field as your horse? (including yours) _____

51. How many of these are:

Male _____ Female _____

WHAT TREATMENTS HAVE YOU TRIED FOR HEADSHAKING?

52. Veterinary Advice Sought [ ] Not Sought [ ]

(please specify)________________________________

Any Improvement? No [ ] Partial [ ] Substantial [ ] Complete [ ]

53. Veterinary Treatments Tried*(please see last page) [ ] Not Tried [ ]

Any Improvement? No [ ] Partial [ ] Substantial [ ] Complete [ ]

54. Back Specialist Tried [ ] Not Tried [ ]

(please specify)________________________________

Any Improvement? No [ ] Partial [ ] Substantial [ ] Complete [ ]

55. Herbal Supplements Tried [ ] Not Tried [ ]

(please specify)________________________________

Any Improvement? No [ ] Partial [ ] Substantial [ ] Complete [ ]

56. Homeopathy Tried [ ] Not Tried [ ]

(please specify)________________________________

Any Improvement? No [ ] Partial [ ] Substantial [ ] Complete [ ]

57. Nose Net Tried [ ] Not Tried [ ]

(please specify what kind)________________________________

Any Improvement? No [ ] Partial [ ] Substantial [ ] Complete [ ]

58. Face Net Tried [ ] Not Tried [ ]

(please specify what kind)________________________________

Any Improvement? No [ ] Partial [ ] Substantial [ ] Complete [ ]

59. A Bitless Bridle Tried [ ] Not Tried [ ]

(please specify what kind)________________________________

Any Improvement? No [ ] Partial [ ] Substantial [ ] Complete [ ]

60. Other Treatments Tried [ ] Not Tried [ ]

(please specify)____

Any Improvement? No [ ] Partial [ ] Substantial [ ] Complete [ ]

61. What combinations are you currently using and how would you rate their effectiveness?

____

____

____

Any Improvement? No [ ] Partial [ ] Substantial [ ] Complete [ ]

62. Any Other Comments?

____

____

____

____

____

____

____

____

____

____

I agree to these details being kept on file for the purposes of research on headshaking by NEHS representatives. I understand that my details will remain confidential and will not be used for anything other than for NEHS matters.

Please sign/print name __________________________ Date ____________

THANK YOU VERY MUCH

Please return to:

Katy Taylor, NEHS Researcher
Dept. of Medical Statistics
Faculty of Computing & Engineering
De Montfort University (Leicester)
The Gateway LE1 9BH U.K.

Email: katyt@dmu.ac.uk
Website: http://www.medstats.dmu.ac.uk/headshaking

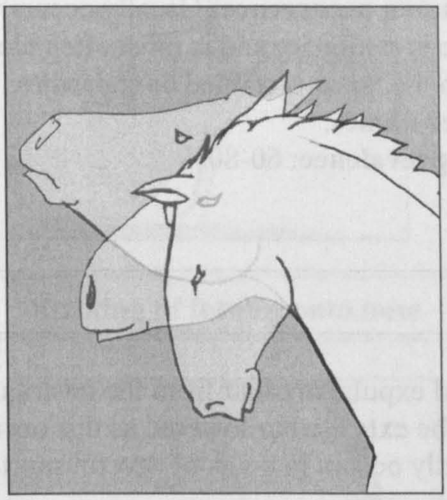
* 53. VETERINARY TREATMENTS (CONT)

Please note down ALL of the treatments listed you and your vet have tried to combat the headshaking. Please make a note even if you have forgotten the name so that with your permission we may contact your vet to obtain more details at a later date.

Treatment type	Details e.g. Name/type/ amount	When? mm/yy	How long for?	Also tried with...?	Any change?	Effect immediate or delayed?	Still used? If not, why not?
Nasal sprays or nebuliser							
Injections							
Tablets							
Creams							
Ear drops							
Temporary nerve block							
Operation on facial nerves							
Any other operation							
Wolf teeth removal							
Supplements							
Other							

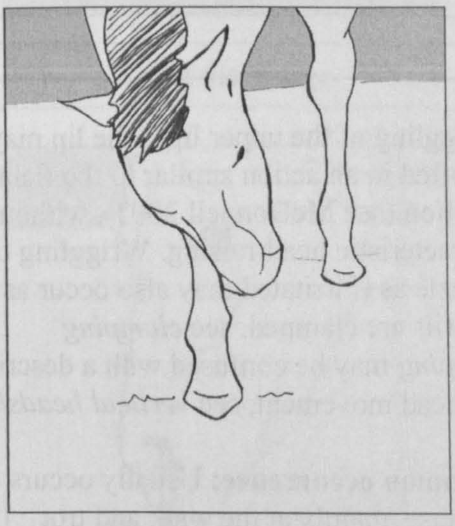
Appendix IV Ethogram of behavioural signs associated with headshaking syndrome

Vertical headshaking



Usually an upward and then downward movement of the head, generated from the neck The speed with which this occurs may vary so that it appears as a nod, a snatch or a rapid flick. The extent of the movement may also vary from a small flick to a large arc of movement. May occur as a single spasm or a series.
Common occurrence: It is seen at any pace, including at rest, although the trot is the most common. It occurs less commonly at canter where the head movement may more closely resemble a rotary headshake
Other names: 'headflicking' (Pinsent 1990), 'head tossing' (Cook 1992, Madigan *et al*. 1995), 'head swinging', 'head throwing' (Madigan *et al*. 1995), head bobbing (McDonnell 2003)
Est. prevalence: 85–100%

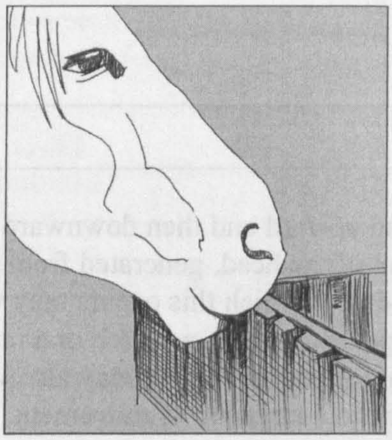
Rubbing nose on foreleg



The head is dropped down and a foreleg extended. Typically the sides of the muzzle or face are then rubbed up and down the foreleg

Common occurrence: May be initiated when the horse is moving but the horse is stationary when this occurs
Other names:
Est. prevalence: 60-80%

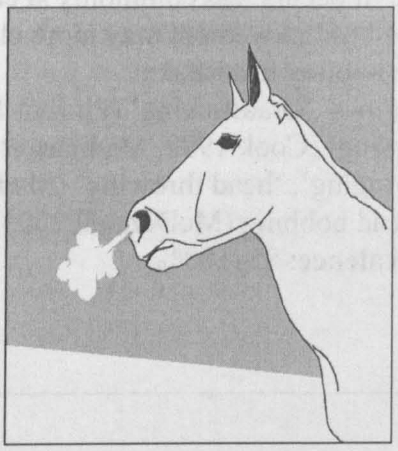
Rubbing nose on objects



The end of the muzzle or side of muzzle and face are moved backwards and forwards or side to side on a stationary object, e.g. a stable wall, top of stable door, on a person, on fence posts

Common occurrence: Usually occurs when the horse is stationary and is most often identified when the horse is stabled or at pasture
Other names:
Est. prevalence: 60-80%

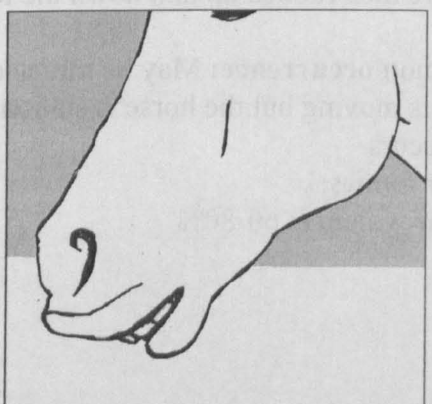
Snorting



Rapid expulsion of air from the nostrils. The head may be extended or lowered as this occurs. Usually occurs in bouts of several snorts

Common occurrence: Most commonly occurs when the horse is exercised, at any pace
Other names: 'High blowing' (Cook 1979b), 'sneezing' (Lane and Mair 1987)
Est. prevalence: 50-80%

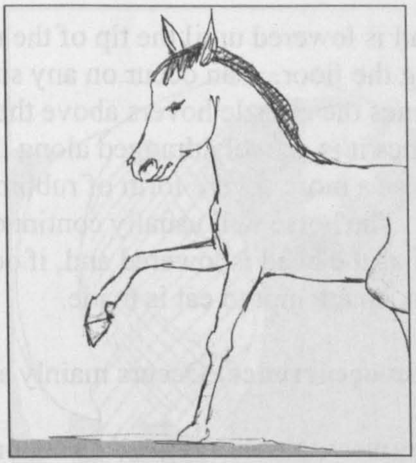
Flipping of top lip/nose



Wriggling of the upper lip. The lip may actually be lifted in an action similar to the flehmen reaction (see McDonnell 2003), without the characteristic head-raising. Wriggling of the muzzle as if irritated may also occur as the nostrils are clamped, see *clamping*
Flipping may be confused with a description for the head movement, see *vertical headshaking*

Common occurrence: Usually occurs during exercise, mainly at the walk and trot
Other names:
Est. prevalence: 20-70%

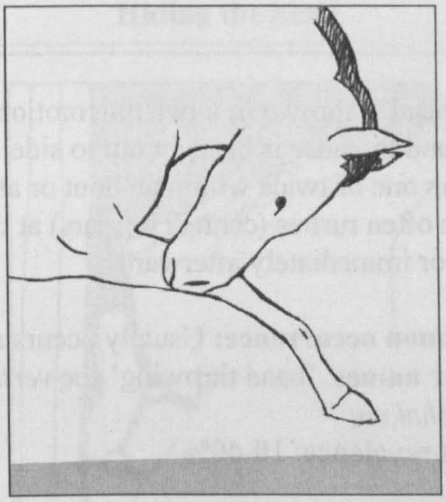
Striking out of foreleg



The foreleg is raised and extended forward rapidly whist the hind legs remain in place. The neck may be arched as this occurs. May be accompanied by a snort or squeal. Almost identical to the 'strike' behaviour listed in McDonnell (2003) that occurs in play or threat behaviour.

Common occurrence: Usually occurs at the faster paces when the horse is particularly agitated
Other names:
Est. prevalence: 20-60%

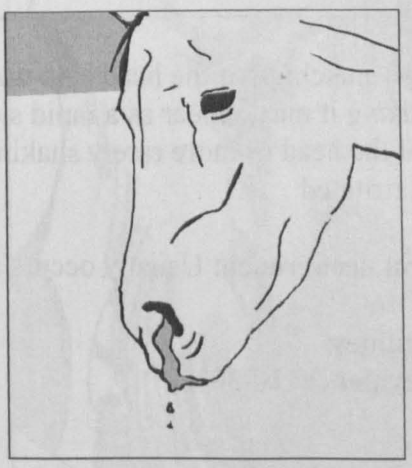
Striking of foreleg onto nose



As *striking out of foreleg* except the head is also lowered so that as foreleg is brought back down it knocks or strikes the side of the nose or face. Potentially a more severe from of rubbing the nose on the foreleg.

Common occurrence: As striking out, it usually occurs at the faster paces when the horse is particularly agitated
Other names:
Est. prevalence: 20-60%

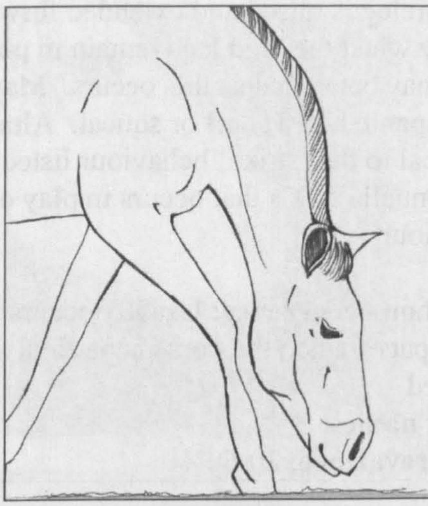
Nasal discharge



A stream of liquid visible as it exits one or both nostrils, usually serous or mucoid. Quantity may vary

Common occurrence: Can occur when the horse is at rest or brought on through exercise, though it is often not apparent until after the rider has dismounted
Other names:
Est. prevalence: 20-50%

Dropping nose to the ground



The head is lowered until the tip of the muzzle is brushing the floor. Can occur on any surface. Sometimes the muzzle hovers above the ground, sometimes it is actively dragged along the ground, as a more severe form of rubbing on objects. The horse will usually continue to move forward as the head is lowered and, if occurring on grass, no attempt to eat is made.

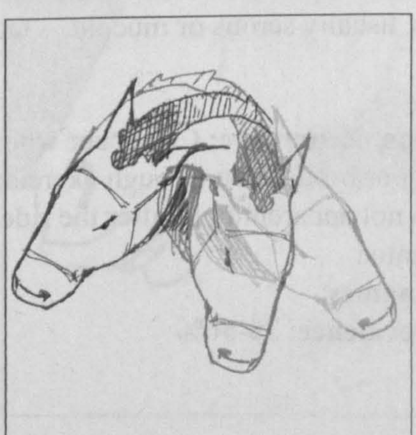
Common occurrence: Occurs mainly at the walk and trot
Other names: 'Nose dragging' (Newton *et al.* 2000), 'rubbing nose on ground' (Mills *et al.* 2002a)
Est. prevalence: 10-50%

Twisting/rotary headshaking

The head is thrown in a twisting motion from the poll and the nose is brought out to side. Usually occurs one or twice within an bout or attack and horse often rushes (canters or rears) at the same time or immediately afterward

Common occurrence: Usually occurs at canter
Other names: 'head throwing' see *vertical headshaking*
Est. prevalence: 10-40%

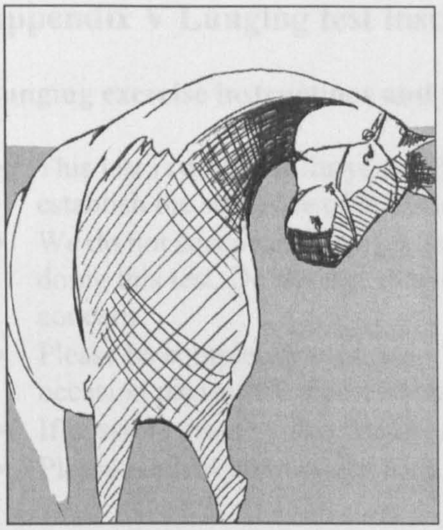
Horizontal headshaking



Sideways snatching of the head. As *vertical headshaking* it may appear as a rapid sideways tilting of the head or more rarely shaking as if the ears are irritated

Common occurrence: Usually occurs at the walk or trot
Other names:
Est. prevalence: 10-30%

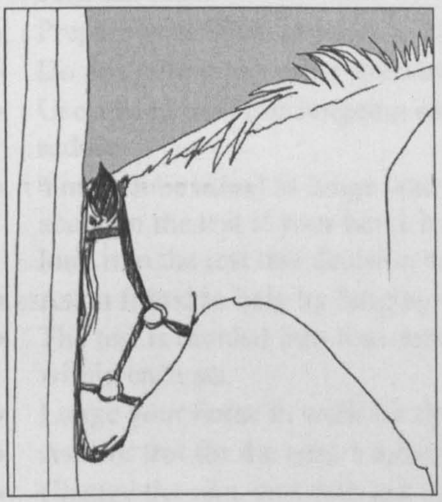
Odd head carriage



The head may be carried higher than usual or lower (see *dropping nose to the ground*). The nose may be poked to one side or the head twisted or tilted to one side. The head may also be head close to the chest in an 'overbent' position.

Common occurrence: Usually occurs at the walk or trot. Head poking might also occur momentarily at rest.
Other names: 'overbent' (Donnelly, pers. comm.), 'head poking', 'nose poking' (pers. obs)
Est. prevalence: 10-30%

Hiding the head



The head, and predominantly the eyes may be shielded by being placed under another horse's tail or in bushes or the head leant against a wall. Predominantly the nose may be placed in a bucket of water or pressed against a wall. The entire head may also be placed inside the stable for example with the rest of the body outside.

Common occurrence: Usually when stationary in the stable or when grazing. Placing the head under another horse's tail may also be attempted at the walk
Other names: 'head pressing' (Newton *et al.* 2000), 'head banging' (Newton *et al.* 2000), in this case the head is repeatedly knocked against a wall.
Est. prevalence: 10-30%

Appendix V Lunging test instructions

Lunging exercise instructions and form

- This test is designed for you to fully assess your horse's behaviour and to enable us to establish the sequence of behaviours
- We do not accept any liability for any injury caused to yourself or your horse whilst doing this test. Do not put yourself at risk or in any situation which gives you cause for concern
- Please be completely accurate – if your horse does not headshake on this particular occasion please still report on the test, as this information is also very important to us
- If possible please video the test and send it in
- Please read all instructions each time before starting any test

Instructions

- Please read through the list of signs carefully first and check you can distinguish between them
- Prepare your horse to lunge a 20 m circle (10 m radius) wherever is convenient
- Do this before any other exercise that day
- Use a head collar or lungeing cavesson if possible, otherwise use a bridle. Do not use a saddle
- You will be asked to lunge your horse for 20 minutes in total. However, feel free to abandon the test if your horse becomes uncontrollable. Please make a note of how long into the test this decision was made on the form
- Ask a friend to help by lunging your horse so that you can concentrate on observing
- The test is divided into four sets of 5 minutes. Write down the signs as they occur within each set
- Lunge your horse in walk for the first 5 minutes
- Ask for trot for the next 5 minutes (Do not ask them to canter)
- Change the rein, and then ask for trot for the remaining 10 minutes
- Do not use a nose net or other preventative treatment during the test unless they are dangerous without it and please note down if you have

Please contact us if you have any questions regarding this test

THANK YOU VERY MUCH FOR YOUR ASSISTANCE

NEHS Ref No: **Horse:**

Date.................................. Time of Test..............................

Number the signs as they occur in each set of 5 minutes. 1 = first sign 2 = second sign,..

Change the rein

	Symptoms	5 mins **walk**	5 mins **trot**	5 mins **trot**	5 mins **trot**	5 mins **after**
A	Vertical headshaking					
B	Horizontal headshaking					
C	Twisting/Rotary headshaking					
D	Odd head carriage					
E	Flipping of top lip/nose					
F	Snorting					
G	Sneezing					
H	Rubbing nose on objects					
I	Rubbing nose on foreleg					
J	Dropping nose to the ground					
K	Striking of foreleg onto nose					
L	Striking out of foreleg					
M	Clamping (shutting) the nostrils					
N	Coughing					
O	Odd/ Heavy breathing					
P	Signs of inflammation Where?.....................					
Q	Sweating? Where?.....................					
R	Nasal discharge (clear/yellow/white) -circle					
S	Twitching? Where?....................					
T	Watering eyes					
U	Blinking					
V	Heavy eyelids/dopey expression					
W	Staring into space					
X	Stumbling/ Incoordination					
Y	Rushing forward/ Panicky					
Z	Unwillingness to move/ Stopping					
	Other.............................					

Additional questions

1. When was the test abandoned? ....minutes

2. Which symptoms were particularly noticeable and disruptive?

....

3. What are you lunging your horse in? (circle one)

Head collar | Lunging cavesson | Bitted bridle | Other (Please specify)

4. How does the behaviour today compare to when **riding out**?

With respect to:

	Severity of signs	*Number* of signs
Much worse	☐	☐
Worse	☐	☐
Same	☐	☐
Better	☐	☐
Much better	☐	☐

If different:

a) Which signs were more/less *severe*?..

b) Which signs were more/less *frequently observed*?......................................

c) Why do you think he/she was different *compared to being ridden out*?

....

5. How does the behaviour today compare to **other days in the headshaking season?**

With respect to:

	Severity of signs	*Number* of signs
Much worse	☐	☐
Worse	☐	☐
Same	☐	☐
Better	☐	☐
Much better	☐	☐

If different:

a) Which signs were more/less *severe*?..

b) Which signs were more/less *frequently observed*?......................................

c) Why do you think he/she was different *today*?

....

Appendix VI Details of horses used in the trials

Table 1. lists the details of the horse used in the trials. Abbreviations are explained below:

Sex: G (Gelding), M (Mare), **YOB:** Year of birth, **H/S Onset:** Month and year of onset of the headshaking problem to the best knowledge of the owner, **Season**: Seasonality of the headshaking (at time of questionnaire): SS (sunny seasonal), PS (perennial with seasonal exacerbations), PE (perennial), **Use**: Use of the horse: P (primarily pleasure), C (affiliated or professional competition), **Breed**: TB (thoroughbred), CB (cob), PO (pony), WB (warmblood), OTH (other type), (X indicates a cross of primarily this type), **Trials involved in**: NN (nose net, year of trial 1998, Mills and Taylor, 2003), BB (bitless bridle, 2001, Chapter 10), FM (face mask, 2001, Chapter 11), MH (magnetic headcollar 2001, Chapter 12), HS (herbal supplement, 2002, chapter 13), VT (video test (owners) 2002, Chapter 8)

Ref	Sex	Y.O.B	H/S Onset	Season	Use	Breed	Trial involved in					
							NN	BB	FM	MH	HS	VT
3	G	1991	?/95	SS	C	TB	y					
4	G	1975	05/97	PE	P	COBX				y		
15	G	1991	06/95	PE	P	TBX	y					
17	G	1980	04/90	SS	P	TB	y					
27	G	1975	?/90	SS	P	COB	y					
28	G	1991	?/96	SS	P	TBX	y					
32	G	1989	04/95	SS	P	OTH	y					
38	G	1990	03/94	PS	C	WB				y		
41	G	1991	03/96	SS	P	COBX	y					y
44	G	1988	?/94	PS	P	TBX	y					
48	M	1993	?/98	SS	C	WB	y					
51	G	1984	05/94	SS	P	PON	y			y	y	
52	G	1988	04/98	SS	C	TBX	y				y	
55	G	1989	?/96	SS	P	TBX	y					
61	G	1987	04/97	SS	C	TBX	y					
63	M	1986	05/96	PS	P	TBX				y		
65	G	1986	05/93	PS	P	PON	y	y	y			y
74	G	1991	06/95	SS	C	OTH	y	y	y		y	
80	G	1989	?/93	PS	P	PON	y					
86	G	1989	03/92	PS	P	COBX	y	y	y			y
93	G	1989	04/93	SS	P	TB				y		
98	G	1984	04/97	SS	P	COB	y	y	y			y
99	M	1989	04/94	SS	P	COB				y		
106	G	1980	?/90	SS	P	TBX	y					
107	G	1981	04/98	PS	P	TB		y			y	
111	M	1981	05/86	PS	P	COBX		y	y	y		y
113	M	1979	05/89	PS	P	OTH	y					y
121	M	1990	06/92	PS	P	COB	y			y		y
130	G	1984	–	SS	P	OTH	y					
139	G	1993	07/97	SS	P	COBX	y			y	y	
144	M	1990	04/94	PS	X	TBX			y			y
147	G	1989	06/95	PE	P	COB	y					
148	M	1991	03/97	SS	C	TB	y					
155	M	1989	03/94	PS	C	OTH	y	y		y		y
159	G	1993	05/95	SS	P	PON	y	y	y			
163	M	1984	06/90	SS	P	WB				y		
166	G	1989	05/95	SS	C	TB	y				y	
167	G	1982	05/93	SS	C	COBX				y		y

Ref	Sex	Y.O.B	H/S Onset	Season	Use	Breed	Trial involved in					
							NN	BB	FM	MH	HS	VT
183	M	1980	05/85	SS	X	TBX	y					
186	M	1991	06/95	SS	P	OTH	y	y				y
191	M	1990	07/95	SS	P	TB	y			y		
192	M	1990	06/95	SS	P	WB	y					
200	G	1980	04/94	PS	C	TB	y			y		
206	G	1989	?/93	SS	P	COB		y	y			y
209	G	1989	10/93	PS	P	PON	y					
211	M	1989	03/97	SS	P	TBX	y					
227	G	1980	05/95	PE	P	TB	y					
241	G	1989	05/93	PS	P	COBX		y	y		y	y
242	M	1983	–	PS	C	OTH				y		y
246	M	1986	05/90	SS	P	COB		y	y		y	
247	G	1992	06/96	SS	P	OTH		y	y			y
257	M	1992	–	SS	P	OTH				y		
502	G	1991	03/99	SS	P	PON		y	y		y	
503	G	1993	04/99	SS	C	OTH		y				y
521	G	1994	04/98	PS	C	OTH		y	y			y
523	M	1991	08/99	SS	P	TB					y	
539	G	1985	05/97	PS	C	TBX		y	y		y	
542	G	1989	09/99	–	C	PON		y	y			y
543	G	1988	06/98	SS	P	PON					y	
544	G	1991	01/98	SS	P	TBX					y	
545	G	1993	08/98	PS	P	COBX		y	y		y	y
548	M	1993	06/99	SS	P	OTH		y	y			
554	G	1984	03/97	PS	P	TB		y			y	
559	G	1993	05/99	PS	P	TBX			y		y	
560	G	1989	08/94	SS	P	PON		y				
561	M	1990	03/97	SS	P	COB				y		
574	G	1989	03/95	SS	P	TB				y	y	
576	M	1996	05/00	PS	C	COB		y	y			y
581	G	1982	08/00	SS	P	OTH					y	
585	G	1996	08/99	SS	C	TB					y	
598	G	1993	08/97	PS	P	OTH			y		y	
604	G	1995	05/00	SS	P	COB			y			
605	G	1990	05/99	PS	P	OTH				y		y
606	M	1991	12/98	PS	C	OTH		y				
608	M	1987	05/97	PS	P	PON				y		
609	M	1987	05/99	SS	P	OTH		y	y			
612	G	1992	10/97	SS	C	PON		y				
616	M	1992	04/98	PS	C	COB		y	y			
623	G	1990	05/95	SS	P	OTH					y	
624	G	1985	–	PS	C	COB		y	y			
626	M	1995	06/98	SS	P	OTH		y			y	y
629	M	1990	05/98	SS	P	OTH					y	
631	G	1990	05/01	SS	C	TBX					y	
635	G	1993	05/01	SS	P	COB					y	
644	M	1995	04/01	SS	C	TBX			y			
645	M	1993	07/01	SS	P	PON					y	
646	G	1988	09/97	SS	P	COB					y	y
651	M	1992	03/00	SS	P	OTH					y	y
652	G	1970	06/97	PS	P	OTH			y			
659	M	1988	05/92	SS	P	COBX					y	
Total number of horses/owners							**36**	**27**	**26**	**20**	**29**	**24**

Appendix VII Instructions for the headshaking video assessment

Many thanks for your help with this aspect of the project. The video evaluation should take about 20 minutes in all. You will see 12, roughlyl minute clips of 12 different horses. They will be clearly separated by a marker. Please follow these instructions:

- Watch the video through once to get used to what you are looking out for and to familiarise yourself with the symptoms listed in the table below
- Then, watch each clip in turn and when you see the marker for the next horse, pause the tape and tick which symptoms you think you have seen in the table below. Please answer as honestly as you can from your own experience
- For each horse please also decide whether you thought they could be described as 'acting like bee flew up its nose' and, based only on what you have seen, whether they acted like what you understand a 'headshaker' to be
- You may watch the video as many times as you like in order to do this
- When you have finished please return this sheet in the pre paid envelope

Video Assessment Form

Clip No.	1	2	3	4	5	6	7	8	9	10	11	12
Vertical headshaking												
Horizontal headshaking												
Twisting/rotary headshaking												
'Flipping' of top lip or nose												
Snorting/sneezing												
Rubbing nose on foreleg												
Rubbing nose on objects												
Dropping nose to the ground												
Striking out of foreleg												
Did the horse?...												
'Act as if a bee had flown up its nose?'												
'Act like a headshaker?' ***(as you understand it)***												

Appendix VIII Informed consent form used in all trials

Thank you for agreeing to take part in the assessment of the <Device> [1] which may act as an alleviator for headshaking, carried out by De Montfort University on behalf of the respective Company [1].

[1] <owned by>

DISCLAIMER

The <Device> is provided to you for assessment purposes only. De Montfort University do not claim that the <Device> is a cure or a controller of headshaking and no representation is given as to its safety or suitability in any particular case.

Please follow the instructions carefully when fitting the <Device> on your horse. You should take all the precautions you deem necessary regarding the safety of yourself, those around you and your horse during the instalment and use of the <Device>. You must monitor your horse's acceptance of the <Device> and exercise your horse in a safe environment.

The <Device> is used entirely at your own risk. Neither De Montfort University, nor the respective Company accept any liability for your horse's behaviour during or after the assessment, or for any damage or injury caused to you, any third party or property, your horse or any other animal.

Please sign below to indicate that you have read and understood the contents of this letter and agree to be bound by its terms:

I agree to monitor the effect of the <Device> on my horse for a period of ....
I understand that I may withdraw from the trial at any time but that I should inform the trial coordinator and return the <Device>.
I give my consent to my details being held on file by De Montfort University for the purpose of research on Headshaking and for any results from the trial to be published by them.

I understand and agree to the conditions specified above:

-- -----/------/-----
Signed Date

Please print name and address:

--- -----/-----/------
For and on behalf of De Montfort University Date

Appendix IX Treatment Assessment Form

Treatment Assessment Form (complete after week 2 of the <Device>)

Ref: Horse:

For the period ..../......../....... To ..../......../....... Ridden / Lunged

Please exercise your horse at least once each week whilst using the <Device>, ensuring you walk the horse for the first 5 minutes before trotting. Please complete the questionnaire at the end of the second week, only taking into account exercise conducted in this way during this last week.

1. **How many times have you exercised your horse in this way this week? ....**

2. **Approx. time for horse to begin headshaking to a noticeable degree ....mins**

3. **Headshaking symptoms during typical exercise this week:**

Mark once anywhere on the scale where you think, on average, your horse's symptoms lie

Vertical Headshaking
never occasionally frequently continually

Snorting/sneezing
never occasionally frequently continually

Dropping nose to ground
never occasionally frequently continually

Rubbing nose on objects
never occasionally frequently continually

Rubbing nose on foreleg
never occasionally frequently continually

Striking at nose
never occasionally frequently continually

'Flipping' nose/top lip
never occasionally frequently continually

4. **What was the typical size of movement in the headshake?**

Size of movement
none small large very large

For example: *barely noticeable flick* *sweeping arc involving entire front end*

5. **How would you rate the overall severity of the headshaking?**

Overall severity
absent quite mild quite severe very severe

Please circle the following answers:

6. How does your horse's headshaking *this* week compare to last week?

1	2	3	4	5	6	7
much worse			same			much better

7. How variable has the headshaking been from day to day?

1	2	3	4	5	6	7
very inconsistent			hard to say			very consistent

8. How would you rate the likelihood of headshaking occurring when your horse was:

	very unlikely*			hard to say			very likely	
Excited	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**N/A****
In bright sunlight	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**N/A**
In the rain	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**N/A**
In the wind	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**N/A**
At rest	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**N/A**
In trigger spots *e.g. hedgerows, midges*	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**N/A**

* If your horse does not headshake under some of these conditions, please tick **1** (very unlikely)
If some of these conditions were not experienced this week, please circle **N/A

9. Assessment of the <Device> (please circle)

a). How would you rate the <Device> for alleviating your horse's headshaking symptoms?

1	2	3	4	5	6
Totally ineffective	Hard to tell	Slightly effective	Partially effective	Very effective	Extremely effective

b). Have you noticed any other change in your horse since using the headcollar?

....

c). When did you first notice any change in your horse since using the <device>?

Immediately   Next Day   During 1st Week   During 2nd Week   Hard To Say   N/A

d). How satisfied are you with the <device>?

1	2	3	4	5	6
Dissatisfied	Hard to tell	Slightly satisfied	Quite satisfied	Very satisfied	Extremely satisfied

Please make any comments you have on the reverse of the questionnaire →
Thank you very much

Appendix X Assessment form and instructions for the herbal supplement trial (Chapter 13)

<u>Trial Instructions</u> **Please begin assessing your horse's symptoms now!**

The trial starts with 2 weeks assessment before you begin the biscuits. To allow you to start the biscuits as soon as they arrive, please begin assessing your horse's headshaking now.

The trial consists of 2 weeks pre-biscuit assessment, 5 weeks assessing the first supplement, 2 weeks rest period with no biscuits (but still assessing) and finally another 5 weeks assessing the second supplement. You will receive your first supplement shortly and the second one exactly 7 weeks later.

Please begin feeding your horse the biscuits as soon as they arrive. Feeding instructions will be enclosed with the biscuits. Please keep all other management as usual where possible.

At least once each week make an assessment of the severity of your horse's headshaking at exercise WITHOUT THE USE OF ANY DEVICE TO CONROL IT, such as nose nets, etc. This may involve a short ride or lunging your horse. If you must use a nose net please ring me for further advice.

Choose the day you first started giving the biscuits as the start of each week and at the end of each week please complete the assessment form for that week's assessment. When the trial has finished please return the assessment form to me as soon as possible using the prepaid envelope.

Completing the assessment form

1. Please write down the *total number of times that week the horse was exercised* for the purpose of the assessment.

2. Please rate the *occurrence* of each of the headshaking symptoms during an average ride, from 0 to 6 using this scale as your guide:

0	*1*	*2*	*3*	*4*	*5*	*6*
never		*occasional*		*frequent*		*continual*

* For Other, you may include one other symptom that is not listed (if you wish) and continue to monitor its occurrence throughout the trial as with the other symptoms. Please keep to this symptom and do not monitor another one later on. Please note changes in any other non-listed symptoms on the reverse of the form.

3. Please rate the *overall severity* of the headshaking and its associated symptoms From 0 to 6 using this scale as your guide:

0	*1*	*2*	*3*	*4*	*5*	*6*
absent		*quite mild*		*quite severe*		*very severe*

5. Please make any comments about each week (change in weather, change in headshaking, etc) on the back of the sheet if you wish, making a note of the week no. you are referring to.

Thank you so much for your assistance in this trial!

Contact details of researcher and manufacturer supplied

LenRys Headshaking Trial Assessment Form **Ref:** **Horse:**

Please complete at the end of every week and refer to the attached instructions for how to complete it.

Treatment	**None**	**None**	**1st Supplement**					**None**	**None**	**2nd Supplement**				
Week No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Date, week ending	…/…	…/…	…/…	…/…	…/…	…/…	…/…	…/…	…/…	…/…	…/…	…/…	…/…	…/…
How many times has the horse been exercised?														
Vertical headshaking														
Snorting/sneezing														
Dropping nose to ground														
Rubbing nose on objects														
Rubbing nose on foreleg														
'Flipping' nose/top lip														
Striking at nose														
Nasal discharge														
Other (please specify)*														
Overall severity														
Any comments? (please write on back)														